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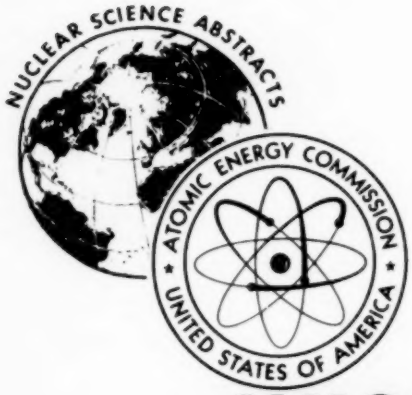

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Volume 16 Number 8

Abstracts 8445–9728

April 30, 1962

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The general description of the five-year cumulation was inadvertently bound with the Cumulative Report Number Index (page iii).

Although the spine, front cover, title page, and introduction of the Cumulative Report Number Index state that the index is a 15-volume cumulation, this notice is being issued for complete clarity. Recipients of the Cumulative Report Number Index may wish to amend page iii to reflect that the Report Number Index covers Volumes 1–15.

Volume 16, Number 8 April 30, 1962

NUCLEAR SCIENCE ABSTRACTS

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NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

8445 (JLI-650-5-2) TRAINING SYSTEMS IN RADIOCHEMISTRY AND RADIOISOTOPE ENGINEERING. (Johnston (William H.) Labs., Inc., Baltimore). Apr. 10, 1961. Contract AT(11-1)-650. 39p.

Training systems were developed as mock-up experiments for laboratory studies in radiochemistry and nuclear engineering. The systems are given in three groups: radiochemical instrumentation group, industrial gaging group, and research and process analysis group. Training units covered include liquid scintillation counting C^{14} and tritium, low-level beta counting, monitoring of natural radon, tracer leak detection, gamma spectrometer, solid state alpha detectors, beta thickness gaging, density and level gaging, tracer flow rates training, tracer wear studies, gas chromatography and radiotracer system, and carbon-hydrogen analyzer. (M.C.G.)

8446 (TID-14560) REACTOR OPERATOR TRAINING REPORT. R. G. Cochran (Texas. Agricultural and Mechanical Coll., College Station). [1961?]. For National Research Council. Committee on Nuclear Science. Contract [AT(40-1)-2061]. 14p.

Results are presented for a six-question survey on reactor operator training sent to seven major research reactor centers. The questions covered the educational requirements, length of training program, subjects covered by training program, and responsibilities of operator in addition to reactor operation. The AEC licensing practices and requirements for a reactor operator are given. Recommendations are made regarding examinations for reactor operators and supervisors. (D.L.C.)

8447 (UCRL-5974-T) POSSIBLE APPLICATIONS OF NUCLEAR ENERGY TO THE MINING INDUSTRY. David D. Rabb (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 15, 1958. Contract [W-7405-eng-48]. 7p.

For presentation at the American Mining Congress, September 24, 1958.

Results of a recent underground test by the Atomic Energy Commission indicate possible applications of nuclear energy in mining and allied industries. The safety, feasibility, and economy of nuclear detonations have been demonstrated and further considerations reveal a number of interesting situations which might lend themselves to the use of this new type of explosive. Possible applications include stripping, crushing, quarrying, and the exploitation of petroleum products, water resources, and low-grade ore deposits. The heat reservoir created by the explosion might be used to produce steam and power to promote the recovery of oil or tar. (auth)

8448 (VDIT-48) LITERATURE SURVEYS AND BIBLIOGRAPHIES PREPARED DURING THE PERIOD FROM JUNE 1959 TO DECEMBER 1961. A Bibliography of Bibliographies. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Dec. 1961. 16p.

A compilation is presented of bibliographic data and abstracts of all literature surveys and bibliographies prepared by the Information Office, Technical and Scientific Information, of Aktiebolaget Atomenergi, from June 1959 to December 1961. The 41 references are arranged under the following headings: physics, physical chemistry, materials, reactor technology, security and safety, measuring and testing, engineering details, biological aspects of nuclear energy, and general questions. (M.C.G.)

8449 (AEC-tr-4140) SELECTED ARTICLES FROM NUKLEONIKA. Translations of Nukleonika, Vol. II, Issue 1, 1-30; 197-206; 221-2(1961). 35p.

A translation of 4 articles from Nukleonika, Vol. II, No. 1, 1957 is presented. The articles cover the following topics: spectrometry of fast neutrons, the role of fast breeder reactors in the development of nuclear power, Czechoslovak-Polish Conference of Nuclear Power Experts, and a bibliography on books in Polish on nuclear science published up to the end of 1956. (M.C.G.)

8450 THE RESOLVING POWER OF MICRORADIOAUTOGRAPHIE EXPOSURES AND ITS DEPENDENCE UPON THE ENERGY OF THE BETA RADIATION. PART II. W. Herrmann, G. Hartmann, and R. Brust (Institut für Angewandte Radioaktivität, Leipzig). Atompraxis, 8: 8-11 (Jan. 1962). (In German)

Direct experimental studies on the energy dependence of the local resolving power of microradioautographic exposures are described. Various possibilities are discussed for preparing the radioactively labeled test grids. Methods for producing them with Ni^{63}, S^{35}, I^{131}, Au^{198}, P^{32}, and K^{42} are given, together with calibration procedure, radioautographic technique, and means of evaluation. The values obtained for each resolving power are compared with the theoretical values, and with the results of the model experiments. Indications for practical application are also given. (auth)

8451 SUB-ACOUSTIC WAVES FROM LARGE EXPLOSIONS. R. V. Jones (Univ. of Aberdeen, Scotland). Nature, 193: 229-32(Jan. 20, 1962)

The Aberdeen records, using two microbarographs of a new design, of the Russian nuclear explosion of October 30, 1961, are reproduced. The passages of the direct and reverse pressure waves are discussed. The times of passage of the first and second direct and reverse disturbances over

Aberdeen were used to estimate the time of the explosion and its distance from Aberdeen. Using microbarograph recordings of the disturbance that originated in Siberia on June 30, 1908, the minimum mass of a meteorite sufficient to have caused the incident was calculated to be at least 30,000 tons. (M.C.G.)

8452 NEITRONY ATOMNOGO VZRYVA. (Neutrons from Atomic Explosions). P. A. Yampol'skii. Moscow, Gosatomizdat, 1961. 132p.

The physical picture of atomic explosion neutrons is discussed, considering neutron physics, reactions of various energy neutrons with substances, neutron diffusion, and neutron flux recording methods. The spatial neutron distribution from air or ground explosions and the role of delayed neutrons are analyzed. The short-life γ emission produced by neutron capture in air (which in some cases comprises 50% of the total γ dose) and the long-life emission from the ground and fission fragments are investigated. The magnitudes of biological doses from atomic explosion neutrons are also discussed. (R.V.J.)

BIOLOGY AND MEDICINE

General and Miscellaneous

8453 (JÜL-23-ST) DIE Cs-137-THERAPIEANLAGE DER KERNFORSCHUNGS-ANLAGE JÜLICH. (Cs-137 Therapy, Installation of the Jülich Nuclear Research Center). D. Nachtigall (Kernforschungsanlage, Jülich, Germany). Nov. 1961. 25p.

The important physical and technical details of the Cs^{137}-therapy installation as well as a series of measurement results are described. Production of the radioactive cesium, its specific activity, and dose output are discussed. The therapy unit is described including source, source strength, the radiative body and its holder, and the instrument board. Dosage as a function of time, dosages in the radiation channel, horizontal dosage distribution in the irradiation room, dosages at 10 cm distance from the radiation source, and dosages in the surrounding rooms were measured. (M.C.G.)

8454 (NP-11251) MOUSE CARCINOGENICITY STUDY. Progress Report, March 1, 1957-September 15, 1961. William B. Deichmann (Miami. Univ., Coral Gables. School of Medicine). Contract DA-49-007-MD-789. 12p.

The study was made to determine whether foods sterilized by irradiation are likely to be carcinogenic by oral ingestion. Results are tabulated for the average weights, food consumption, and survival of the mice of the 7th, 8th, 9th, and 10th replicates. The incidence of apparent tumors was observed grossly for the 5th, 7th, 8th, 9th, and 10th replicates. The results did not indicate that the feeding of irradiated foods caused an increase in tumor incidence. (B.O.G.)

8455 (NP-11254) THE EFFECT OF CONTROL-GROUND BEEF AND IRRADIATED 5.58 MEGARAD-GROUND BEEF CONSUMPTION ON REPRODUCTIVE PERFORMANCE IN THE BEAGLE. Progress Report No. 3, March 15, 1961-September 15, 1961. Thomas B. Clarkson and Alvin F. Moreland (Wake Forest Coll., Winston-Salem, N. C. Bowman Gray School of Medicine). Contract DA-49-193-MD-209A. 4p.

Progress is reported in studies on the effects of feeding radiation-processed beef on the body weight maintenance, food consumption, hematological values, or results of urine analysis in dogs. (C.H.)

8456 (NP-11256) ON THE NUTRITIVE VALUE OF THE MAJOR NUTRIENTS OF IRRADIATED FOODS AND APPRAISAL OF THE TOXICITY OF IRRADIATED FOODS. Progress Report No. 20, March 1, 1961-September 1, 1961. P. B. Rama Rao, A. M. Paolucci, and B. Connor Johnson (Illinois. Univ., Urbana). Contract DA-49-007-MD-544. 18p.

Progress is reported in studies of the effects of vitamin K deficiency on oxidative phosphorylation systems in rat liver mitochondria. Preliminary results are included from a study of the nutritional status of monkeys maintained on vitamin K deficient diets. The effects of vitamin K deficiency on the incorporation of C^{14}-labeled amino acids into body protein in monkeys and the possibility of producing vitamin K deficiency in rats fed a synthetic diet were also investigated. (C.H.)

8457 (NP-11257) LONG-TERM RABBIT AND HAMSTER FEEDING OF IRRADIATED AND CONTROL FOODS AND ITS EFFECTS UPON THE BLOOD SERUM CONSTITUENTS (PHASE 1) AND NUTRITIVE VALUE OF IRRADIATED PROTEINS AND CONTROL PROTEINS (PHASE 2). Progress Report No. 9, Six-months period ending September 15, 1961. D. F. Watson, R. M. Smibert, and R. W. Engel (Virginia. Agricultural Experiment Station, Blacksburg). Contract DA-49-007-MD-784. 6p.

Results are tabulated from a long-term study on the effects of a diet containing irradiated foods on the blood serum constituents of hamsters and rabbits. (C.H.)

8458 (NP-11259) RADIOISOTOPES IN RADIATION PROCESSED FOODS. Period covered: March 16, 1961-September 15, 1961. George R. Meneely (Vanderbilt Univ., Nashville. School of Medicine). Contract DA-49-193-MD-2101. 30p.

Data are tabulated on the observed isotopes, and their specific activities, produced in pork, beef, and chicken by exposure to electron beams of various energies. Continuous exposure values were calculated from the consumption of these irradiated meats, modified by assuming 0.10 the total diet to be meat. (C.H.)

8459 (NP-11260) LONG-TERM DOG AND RAT FEEDING EXPERIMENT EMPLOYING IRRADIATED EVAPORATED MILK. Period covered: March 1, 1957 to August 1, 1961. William B. Deichmann (Miami. Univ., Coral Gables, Fla. School of Medicine). Contract DA-49-007-MD-785. 38p.

Evaporated milk irradiated at a level of 5.58 megarad and 2.79 megarad was fed to rats for a period of two years. Non-irradiated evaporated milk of similar origin was used as the control. A breeding experiment was carried out in which rats fed irradiated evaporated milk were bred through four generations. Hematological data were collected and complete histopathological studies were made on tissues. No indication was seen of any toxic effect due to feeding the irradiated food. (C.H.)

8460 (NP-11278) LONG-TERM RAT FEEDING EXPERIMENT WITH IRRADIATED BEEF. Final Report, Section I-Procedures and Laboratory Results. Frank R. Blood, William J. Darby, George Elliott, et al. (Vanderbilt Univ., Nashville. School of Medicine). [nd]. Contract DA-49-007-MD-779. 85p.

No adverse effects were demonstrated as evidenced by growth, hematology, food efficiency, reproduction, mortality, or gross pathology in rats maintained for four generations on a diet containing irradiated beef. Data are tabulated. (C.H.)

8461 (NP-11286) THE GROWTH, BREEDING, LONGEVITY AND HISTOPATHOLOGY OF RATS FED IRRADIATED OR CONTROL FOODS — TISSUE ENZYME STUDIES. Final Report. Ian J. Tinsley and Edward C. Bubl (Oregon. Agricultural Experiment Station, Corvallis). Apr. 1, 1957. Contract DA-49-007-MD-580. 18p.

Results are reported from a long-term study of the effects of a diet containing irradiated pork, jam, or carrot ration on tissue enzyme changes in rats. Data are tabulated and results discussed. (C.H.)

8462 (NP-11298) REPORT OF HISTOLOGIC OBSERVATIONS [ON] NUTRITION: SUBTASK, RADIATION AND STERILIZATION OF FOODS FOR THE UNIVERSITY OF MICHIGAN, ANN ARBOR, MICHIGAN. M. A. Ross and

Elizabeth Hood (Armed Forces Inst. of Pathology, Washington, D. C.). [nd]. 54p.

The possible effect of long term feeding of foods preserved by irradiation was investigated in coordinated histological studies. Two groups of rats, each including 25 males and 25 females, were fed potatoes that had been irradiated. Potatoes exposed to irradiation of 13.5 to 20 kilorads were fed to one group; those exposed to irradiation of 27 to 40 kilorads were fed to the second group. A third group consisting of 26 males and 25 females was fed unirradiated potatoes and served as controls. All rats received sufficient supplemental items to provide what was considered to be an adequate nutritional intake. Although no definite patterns emerged on an over-all basis it appeared that in some organs (spleen, kidney, testis, and mesenteric vessels) there was an increased prevalence of some conditions that could possibly be ascribed to sex, and/or level of irradiation. (auth)

8463 (NYO-9574) A STUDY OF THE EFFECTS OF SUB-STERILIZATION DOSES OF RADIATION ON THE STORAGE LIFE EXTENSION OF SOFT-SHELLED CLAMS AND HADDOCK FILLETS. Quarterly Progress Report, November 1961–January 1962. John T. R. Nickerson, Samuel A. Goldblith, and Edmund B. Masurovsky (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2329. 35p.

Total aerobic-facultative and anaerobic macrocolony count data, together with the frequency distributions of aerobic-facultative isolates, are presented complete with analyses and interpretation for both haddock fillets and shucked, soft-shelled clams. The total microbial count of haddock fillets irradiated at 400,000 rad remained below 4×10^5/gram during storage for two weeks at 0°C, whereas the non-irradiated controls attained counts of over 5×10^7/gram under identical conditions of storage, and had counts of over 6×10^6/gram after 8 days at this temperature. Fresh, non-irradiated shucked clams approached a state of bacterial spoilage (>1×10^6/gram) after about a week in refrigerated storage, whereas samples irradiated at doses of 800,000, 750,000, 700,000, and 650,000 rad remained below 1×10^4/gram after one month of storage under the same conditions. (M.C.G.)

8464 (TID-14828) RADIOIODINE STUDIES OF FETAL AND OTHER THYROIDS. Technical Progress Report, January 1962. [Titus C. Evans] (Iowa. State Univ., Iowa City. Radiation Research Lab.). Contract AT(11-1)-291. 14p.

An experiment was conducted on whether I^{131}-labeled triiodothyronine would cross the placenta from the maternal to the fetal circulation. The labeled triiodothyronine was given to the mother by mouth and 16 hr later the 12- to 14-week fetus was removed surgically; the percentage uptake in the fetal thyroid was found to be 0.001%, ~$^1/_{10}$ of that expected for a 12-week fetus. An attempt was made to determine the percentage uptake for NaI^{131} tracer, and the possibility of the activity of the labeled triiodothyronine transferring as such instead of as NaI is discussed. In the use of I^{131}-labeled albumin to determine the blood volume of a pregnant patient with extreme hydramnios and apparent anemia, no activity was found in the amniotic fluid of the fetus a few hr later. A study was made of the thyroid function during fetal development, at birth, after birth, and in children. The preliminary results indicate that the uptake in the fetus increases asymptotically to a value of 2 to 3% near birth and increases tremendously after birth to 15 to 90%. (D.L.C.)

8465 (TID-14853) PROGRESS REPORTS ON CURRENT RESEARCH [IN MARINE BIOLOGY]. (Marine Biological Lab., Woods Hole, Mass.). 1961. 300p. Contract [AT(30-1)-1343].

The current picture of research at the Marine Biological Laboratory is presented. One hundred and seventy-three research projects are discussed. (M.C.G.)

8466 (AEC-tr-4628) MITOCHONDRIAL RESPIRATION AND RESPIRATORY-CHAIN PHOSPHORYLATION INCIDENT TO INCREASED INTRAMITOCHONDRIAL TOTAL FAT CONTENT. Dieter Neubert and Inge Hoffmeister. Translated from Arch. exptl. Pathol. u. Pharmakol., 238: 348-57(1960). 24p.

Studies were made to determine if a marked damage of the mitochondrial structure and thereby a performance reduction of these cell organoids occurs under conditions of a definite "mitochondrial fatty metamorphosis." The experiments were carried out on female rats of the inbred strain E-3. It was demonstrated that an increased fatty content within the mitochondria is not necessarily associated with a distrubance in the respiratory and phosphorylative chain. (M.C.G.)

8467 (JPRS-11405) CYTOLOGY. Translation of Tsitologiya, 3: No. 2, 125-51; 154-65; 167-86; 189-240 (Mar.-Apr. 1961). 164p.

Separate abstracts were prepared on two selected articles in this issue. (C.H.)

8468 (JPRS-11405(p.40-55)) THE STABILITY OF PARAMECIA, ADAPTED TO LIFE IN WARM RADIOACTIVE SPRINGS, TO VARIOUS EXTERNAL AGENTS. L. K. Lozina-Lozinskii (Lozina-Lozinskiy). Translated from Tsitologiya, 3: No. 2, 154-65(Mar.-Apr. 1961).

Populations of Paramecium aurelia and P. multimicronucleatum, found in radioactive, warm Slavynovskiy springs (with a temperature to 35°) are characterized by great resistance to high doses of x rays, to high lethal temperature, to prolonged action of sublethal temperatures, and to certain inhibitory enzymes, particularly to dinitrophenol, hydroxylamine, and methylene blue, in comparison with a population from other reservoirs. In a population of P. multimicronucleatum, the thermal resistance of succinic dehydrogenase also increases. The same populations demonstrate a decrease in resistance in relation to certain chemical agents, for example P. aurelia to hydrogen cyanide and hydrogen peroxide. A population of P. multimicronucleatum from the warm Slavyanovskiy spring and the cold Pyatigorsk pond evidence no differences in their reaction to ultraviolet rays and increased hydrostatic pressure. (auth)

8469 (JPRS-11405(p.67-73)) THE ACTION OF GAMMA-RADIATION ON THE STRUCTURE OF QUIESCENT PARTICLES OF BACTERIOPHAGE. Yu. P. Vinetskii (Vinetskiy) and G. E. (Ye.) Fradkin. Translated from Tsitologiya, 3: No. 2, 176-82(Mar.-Apr. 1961).

Gamma irradiation, at doses to 100,000r, of a T-4 phagal suspension in a synthetic medium, i.e., in conditions of indirect radiation effect, resulted in an abrupt loss of virus reproductive ability. The structure of a significant majority of phagal particles did not undergo noticeable changes. (auth)

8470 (JPRS-12194) RADIATION STERILIZATION OF ANTIBIOTIC PREPARATIONS. V. I. Pochapinskii (Pochapinskiy), Z. V. Ermol'eva (Yermol'yeva), and A. Kh. Breger. Translated from Med. Prom. S.S.S.R., No. 9, 28-33(1961). 18p

Investigations were conducted on the radiosterilization and its effects on the properties of streptomycin sulfate, dihydrostreptomycin, streptomycin calcium chloride complex, pasomycin, and streptopenicillin. Radiosterilization was carried out with the K-20,000 Co^{60} source at doses from 1.5 to 8 Mrad, and the minimal sterilization dose was determined to be 2.5 Mrad. The irradiated preparations were found to retain their antibiotical activity up to the 8-Mrad dose level, and the lowering in the pH of their aqueous solutions was well within limits. The coloring of the irradiated preparations was determined by optical density measurements in aqueous solutions. (D.L.C.)

8471 INCORPORATION OF ^{32}P INTO THE PHOSPHORUS COMPOUNDS OF THE WAX MOTH LARVAE (GALLERIA MELLONELLA). Paulina Włodawer (Nencki Inst. of Experimental Biology, Warsaw). Acta Biochim. Polon., 8: 321-35(1961). (In English)

With the aid of P^{32}, given as orthophosphate, the phosphorus metabolism in the feeding and in the starved wax moth larvae was studied. The P^{32} content of the acid-soluble P fraction, which was very high at completion of the radioisotope ingestion, fell abruptly during the subsequent period of normal feeding. The fall in the specific activity of the acid-soluble P compounds was accompanied by an increase in the specific activities of the phospholipids and nucleic acids. The phospholipid specific activity reached its maximum 24 hr. after cessation of P^{32} ingestion and exceeded the activity of the acid-soluble P fraction. Practically all of the P^{32} excreted by the larvae was found in the polyphosphates. During starvation the fall in the specific activity of the acid-soluble P fraction was less pronounced than during feeding while the changes in the specific activities of the phospholipids and the nucleic acids were rather insignificant. Uniformity of labelling was found to occur in the acid soluble P compounds of the starved but not of the fed larvae. (auth)

8472 MACRO-RADIOAUTOGRAPHIC LOCALIZATION OF BROMINE-82, RUBIDIUM-86 AND PHOSPHORUS-32 IN THE CANINE KIDNEY. O. Andrysek, O. Schueck, and J. Andryskovâ (Charles Univ., Prague). Nature, 193: 283-4(Jan. 20, 1962).

The distributions of bromides, rubidium, and phosphorus in the kidney were determined using radioisotopes. Seven dogs with an average weight of 20 kg were used for the tests. Br^{82} concentration in the kidney increased in the medulla. Rb^{86} appeared to collect predominantly in the cortex, with a lower concentration in the medulla. P^{32} was also collected chiefly in the cortex. Several zonal dislocations were observed. (M.C.G.)

8473 DETERMINATION OF RADIATION DOSE DURING FLUOROSCOPIC PROCEDURES WITH THE AID OF THE FLUOROSCOPIC SIMULATOR. W. B. Miller, Jr., R. H. Rohrer, and H. S. Weens (Emory Univ., Atlanta). Radiology, 78: 237-9(Feb. 1962).

The problem of measuring fluoroscopic radiation doses was approached by the use of an electromechanical system capable of recording routine fluoroscopic procedures and later reproducing them in the laboratory for domestic study. Five parameters are recorded to obtain x-ray beam area, beam position, and exposure time. The playback system consists of a fluoroscopic simulator and data processor. An initial study of the relationship of the field size and x-ray exposure time with other factors in the fluoroscopic procedure was undertaken. (M.C.G.)

8474 BARRIER AND FILTER EFFECT OF VEGETATION WITH RESPECT TO VOLATILE RADIOIODINE. Walter Herbst (Universität, Freiburg i. B.). Strahlentherapie, 116: 420-5(Nov. 1961). (In German)

Surface organs of plants, in comparison with inert models, such as cellulose, have a higher capture effectiveness by one order for volatile radioiodine. About 0.1 to 0.5 μc per gram of leaf mass is deposited within one week at an immission of 10^{-5} to 10^{-3} μc I^{131} per hour and per cm^3 of air. Leaves of dicotyledons are more effective in capturing than pins of conifers. Partly, radioiodine is deposited loosely on the surfaces of the plant organs; partly, it is incorporated into the interior of the plants and bound to proteins. The response of the plants to volatile radioiodine can be considered a protective mechanism for life and nutrition areas of humans. (auth)

8475 THE EFFECT OF SOME POLYAMINOPOLYCARBOXYLIC ACIDS ON THE DISTRIBUTION OF THORIUM-234 IN THE RAT ORGANISM. Alexander Catsch and Glauco P. Tocchini-Valentini (Kernforschungszentrum, Karlsruhe, Ger.). Strahlentherapie, 116: 426-34 (Nov. 1961). (In German)

The distribution of Th^{234} in the organism of the rat as affected by several polyaminopolycarboxylic acids was studied. Diethylenetriaminepentaacetic acid proved to be superior to ethylenediaminetetraacetic acid in enhancing the excretion of Th^{234}. A still higher mobilization of Th^{234} could be achieved by triethylenetetraaminehexaacetic acid. The effectiveness of these chelating agents is reduced in delayed treatment as well as in the case of isotopic dilution of Th^{234}. The ester or lactone of the hydroxyethylenediaminetriacetic acid and bis(2-hydroxycyclohexyl)ethylenediaminediacetic acid showed no higher effectiveness than the corresponding calcium chelates. (auth)

8476 SUBCUTANEOUS INDURATIONS AFTER TELECOBALT THERAPY. Rudolf Birkner and Bruno Hoffmann (Städt. Krankenhaus Moabit, Berlin). Strahlentherapie, 116: 463-77(Nov. 1961). (In German)

A report is made about 24 cases of subcutaneous induration, which appeared as reversible late effects of cobalt-60 deep therapy. The cause of these lesions is supposed to be a summation effect of several radiogenic, local biologic, and common factors. The clinical symptoms of, and the therapeutical and prophylactical measures for, these subcutaneous changes are discussed. (auth)

8477 INDUCTION OF TRANSPLANTATION IMMUNITY IN THE NEWBORN MOUSE. J. G. Howard and Donald Michie (Univ. of Edinburgh). Transplantation Bull., 29: 1-6(Jan. 1962).

Results of tests of immunological reactions in newborn mice, following the injection of spleen cells from newborn rats, adult rat spleen cells, spleen cells from adults of a different strain, spleen cells from irradiated donors of several mice strains, and spleen cells from irradiated litter-mates, led to the conclusion that the newborn possess well-defined powers of immune response when exposed to the same histocompatibility antigens which in higher doses are known to induce tolerance. Experimental results are tabulated. (C.H.)

8478 RADIOAKTIVITÄT IN LEBENSMITTELN. MESSMETHODEN, PROBEENTNAHME, BEURTEILUNG DER MESSERGEBNISSE. KOLLOQUIUM DES "SONDERAUSSCHUSS RADIOAKTIVITÄT" AM 3. UND 4. DEZEMBER, 1959, IN KARLSRUHE. (Special Selections on Radioactivity. Colloquium on Radioactivity in Food. Measurement Methods, Sample Selection, and Evaluation of Re-

sults). No. 15 of "Schriftenreihe des Bundesministers für Atomkernenergie und Wasserwirtschaft. Strahlenschutz." Munich, Gersbach & Sohn Verlag GmbH, 1960. 56p. DM 4.

A colloquium on radioactivity in foods is presented. Topics covered include biological importance of results, sample selection for the investigation of contaminated food, radiochemical determination of strontium isotopes, apparatus and methods for measurements, and interpretation of measurements. (M.C.G.)

8479 HUMAN RADIATION EQUIVALENT DUMMY. Samuel Weir Alderson. British Patent 888,107. Jan. 24, 1962.

A radiolucent hollow shell in the form of a human body is designed for radiation studies. The shell contains a skeleton and has a plurality of openings for the introduction of dosimeters and solutions. Compartments are also provided for the simulation of organs. (D.L.C.)

Biochemistry, Nutrition, and Toxicology

8480 (NYO-10057) FINAL CONTRACT REPORT [ON UPTAKE OF P^{32} BY PROSTATE GLAND]. David M. Sklaroff (Albert Einstein Medical Center, Philadelphia). [1961]. Contract AT(30-1)-2405. 10p.

The differential uptake of tracer doses of P^{32}, Rb^{86}, and Zn^{65} by carcinomas of the prostate gland was not sufficient for use in diagnosis of this condition. Although a higher specific activity was observed in carcinoma tissue following administration of the radioisotopes, there was considerable overlap, which eliminates the method as a reliable diagnostic technique. (C.H.)

8481 (TID-13328) RADIUM AND MESOTHORIUM POISONING AND DOSIMETRY AND INSTRUMENTATION TECHNIQUES IN APPLIED RADIOACTIVITY. Annual Progress Report. (Massachusetts Inst. of Tech., Cambridge). May 1961. Contract AT(30-1)-952. 138p.

Progress in research on radium and mesothorium toxicity in human beings is reported. Developments in nuclear physics, dosimetry, and instrumentation techniques are described. (M.C.G.)

8482 (TID-14430) NUCLEOTIDES. III. SYNTHESIS AND EFFECTS WITH CELLS IN CULTURE OF I^{131}-LABELED 5-IODO-2'-DEOXYURIDINE 5'-PHOSPHATE. Alexander Hampton, E. Gambetta Hampton, and Maxwell L. Eidinoff (Sloan-Kettering Inst. for Cancer Research, New York). [1961]. Contract AT(30-1)-910. 13p.

A procedure is described for the convenient chemical synthesis of I^{131}-labeled-5-iodo-2'-deoxyuridine 5'-phosphate. Results are reported from a study of its effectiveness as an exogenous source for the incorporation of 5-iodouracil into deoxyribonucleic acid of cells in culture. (C.H.)

8483 (TID-14845) THE QUANTITATIVE EVALUATION OF FACTORS IN MEASUREMENT OF Sr^{90} BURDEN OF LIVE RATS (thesis). Richard D. Neff (Kansas. Univ., Lawrence. Graduate School). Jan. 1959. 44p.

Bremsstrahlung from $Sr^{90}-Y^{90}$ was counted in a NaI(Tl) crystal detection system for evaluating the body burden of adult live rats. The effect of increasing the mass of standard homogenate of equal activity on the count rate was found to cause a linear decrease in counts per minute for the counting geometry used. After correcting for diferences in weight using this relationship, the rate of homogenate dps to apparent dps in a live rat was found to be constant over a range of 175 grams rat body weight. A method for determining the activity in a live animal was developed by using the weight correction and then the geometrical correction factors. An additional geometry factor introduced by pregnancy in the female rat was investigated and found to be important only in the last few days of pregnancy. (auth)

8484 (TID-14849) INFLUENCE OF PARATHYROID EXTRACT AND CITRIC ACID ON THE EXCRETION OF Sr^{90} FROM NORMAL RATS, LACTATING RATS, AND RATS SUFFERING CALCIUM OR PHOSPHORUS DEFICIENCIES (thesis). Vernon S. Bishop (Kansas. Univ., Lawrence. Graduate School). Jan. 1960. 65p.

An investigation was conducted on the effects of parathyroid extract and sodium citrate in conjunction with various diets and lactation on the removal of Sr^{90} from rats which were injected with $Sr^{90}Cl_2$ at least 3 weeks before treatment. No increase in Sr^{90} excretion was observed as a result of treatments with parathyroid extract to rats on a normal diet, rachitogenic diet, calcium-deficient diet, and low-phosphorus diet. Citrate does not increase the rate of Sr^{90} excretion in rats on a normal diet. There are indications that parathyroid extract and citrate may suppress Sr^{90} excretion. Lactation definitely increases Sr^{90} excretion, especially in the latter stages. It is concluded that McLean's theory of parathyroid action is incomplete. (D.L.C.)

8485 (TID-14858) THE INFLUENCE OF HYDROXY-CARBOXYLIC ACIDS ON THE DEPOSITION AND EXCRETION OF HAFNIUM-181 IN RATS WHEN INJECTED SUBCUTANEOUSLY (thesis). Roger D. Tippetts (Kansas. Univ., Lawrence). May 1960. 107p.

An investigation was made of the effect, if any, on the rate of deposition and excretion of Hf^{181} in rats under the action of hydroxycarboxylic acids as chelating agents. It is shown that Hf^{181} as hafnium oxychloride can have its pH raised to as much as 8 by the use of the hydroxycarboxylic acids or sodium carbonate without the formation of a permanent precipitate or colloid. The excretion of Hf^{181} for the various chelating agents was rapid at first and much slower somewhat later. The excretion was remarkably similar from acid to acid. The chelating agents in a few cases seemed to prevent Hf^{181} deposition in several tissues or remove deposited Hf^{181} from the several tissues. (M.C.G.)

8486 (UCLA-498) THE BI-DIRECTIONAL TRANSPORT OF RADIOSTRONTIUM ACROSS THE PRIMATE PLACENTA. Norman S. MacDonald, Donald L. Hutchinson, and Marilyn Hepler (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). Dec. 1961. Contract AT-04-1-GEN-12. 25p.

The simultaneous transport of radiostrontium from mother to fetus and from fetus to mother was studied in two pregnant rhesus monkeys at term. Carrier-free Sr^{85} was injected into the circulation of the intrauterine fetus simultaneously with the injection of carrier free Sr^{90} into the maternal circulation. Serial samples of fetal and maternal blood as well as amniotic fluid were obtained and assayed for a period of 70 minutes post injection. One fetus and mother was sacrificed and various tissues as well as the carcasses were assayed for total Sr^{85} and Sr^{90} content. The disappearance of radiostrontium from the circulatory system into which it was injected was rapid and could be described by a power function of time during the period 10 to 70 minutes. The maximum concentration

of radioisotope appeared in the contiguous circulation at 10 to 20 minutes after injection. Although the data did not permit quantitative compartmental analysis and description of transfer rates, it was demonstrated that strontium rapidly traversed the placenta passing from fetal blood to maternal blood, as well as in the reverse direction. Strontium which entered either the fetal or maternal blood via placental transfer was deposited in a manner equivalent to strontium injected directly into the blood. Fetal bone had a greater avidity for Sr per unit weight than did maternal bone but the larger mass of soft tissue and bone in the maternal organism resulted in the "fixation" of much more radioactivity in the mother than in the fetus. Both isotopes rapidly entered the amniotic fluid. The isotope from the fetal circulation appeared faster, reached a higher concentration, and attained equilibrium sooner than that from the maternal circulation. Observations of differences in tissue distribution and disappearance rates from the circulatory system were interpreted without invoking a specific dynamic mechanism for directional discrimination by the primate placenta. (auth)

8487 (AEC-tr-4640) EXPERIMENTAL STUDIES ON THE EFFECT OF RARE EARTHS ON THE FUNCTIONS AND ANATOMY OF THE LIVER. F. Fischler and K. W. Roeckl. Translated from Arch. exptl. Pathol. u. Pharmakol., Naunyn-Schmiedeberg's, 189: 4-21(1938). 22p.

Salts of the rare earths such as chlorides, acetates, and nitrates, injected intravenously, brought about an irreversible lack of coagulability of the blood, lasting up to many hours according to the dosage used, after which the properties of the blood returned to normal. Injection of higher doses of the salts caused, in the liver, transient degenerative lesions in terms of a central lobular necrosis, which was followed by vigorous regeneration at the cessation of the salt effect. At the height of the influence of the salts, the laboratory animals exhibited a sudden drop in weight, a fall of the blood sugar level, and presence in the urine of tyrosine, leucine, and urobilin. These phenomena receded within a few days as the influence of the salt subsided. It was concluded that the cause of the clinical and anatomic reactions was paralysis of the internal secretory fermentations in the liver. The term "hypoglycemia due to paralysis of hepatic fermentation" was proposed for this type of hypoglycemia. The autolytic fermentative effects remained uninfluenced by the salts. From the pathologic anatomic aspect acute yellow atrophy of the liver and central lobular necrosis were equal phenomena, except for the difference in the site of attack by the injurious agents. (auth)

8488 A COMPARISON OF THE DISTRIBUTION OF RADIOACTIVE FLUORINE AND CALCIUM BY USE OF DOUBLE-ISOTOPE AUTORADIOGRAPHY. Lars-Erik Appelgren, Yngve Ericsson, and Sven Ullberg (Royal Veterinary Coll., Stockholm and Royal Dental School, Stockholm). Acta Physiol. Scand., 53: 339-47(Nov.-Dec. 1961). (In English)

The autoradiographic distribution picture was compared in whole pregnant mice and young rats at short intervals after the injection of fluorine (NaF^{18}) and calcium ($Ca^{45}Cl_2$). The isotopes were injected intravenously on the same animal and selective registration of F^{18} and Ca^{45} was made utilizing the great difference in decay rates. Both isotopes, especially Ca^{45}, were rapidly taken up from the blood. F^{18} accumulated more rapidly and selectively in hard tissues while Ca^{45} was taken up in appreciable amounts in some soft tissues. The distribution pattern in bone and in dentine was very similar for F^{18} and Ca^{45}. F^{18} was taken up in proportionately low concentration in the calcifying molar enamel. Ca^{45}, but not F^{18}, was taken up in the cartilage of young animals. A remarkably high accumulation of Ca^{45} was seen in some groups of striated muscles. These muscle groups may be those which were contracted when the lightly anesthetized animal was sacrificed by immersion in the freezing mixture. The dominating excretory organ for F^{18} was the kidney while high concentrations of Ca^{45} appeared in the mucosa and contents of the small intestine. (auth)

8489 SPECIFICITY OF ZINC PATHWAY THROUGH THE BODY: TURNOVER OF Zn^{65} IN THE MOUSE. George C. Cotzias, Donald C. Borg, and Bernell Selleck (Brookhaven National Lab., Upton, N. Y.). Am. J. Physiol., 202: 359-63(Feb. 1962). (BNL-5588)

An isotopic study is presented which shows that zinc metabolism is controlled by at least two homeostatic mechanisms which act at the sites of absorption and of intestinal excretion, respectively. Zinc was the only element which, when used as a metabolic load, accelerated the elimination of Zn^{65}. Among its neighbors in the transition series, copper and gallium were ineffectual. Among the members of group II of the elements cadmium decelerated the excretion of Zn^{65} slightly, whereas magnesium was without demonstrable effect. The significance of these findings relative to the specificity of zinc's pathway through the body is discussed. (auth)

8490 CALCIUM HOMEOSTATIC MECHANISMS AND UPTAKE OF RADIOISOTOPES IN THE LOBSTER. Dora K. Hayes, Leon Singer, and W. D. Armstrong (Univ. of Minnesota, Minneapolis). Am. J. Physiol., 202: 383-6 (Feb. 1962).

Hemolymph calcium levels were decreased by one-half by placing lobsters in artificial sea water containing less than 1 mEq/liter calcium ion. In these animals sodium and phosphate content of dry shell was increased but the shell calcium content was not detectably altered. Calcium appearing in the bathing medium was apparently derived from two sources. While control animals exhibited a significant ability to select calcium in preference to strontium only in gill and mandible tissue, almost all tissues of hypocalcemic animals showed significant uptake of Ca^{45} over Sr^{85}. Claw shell acquired more isotope per gram of dry weight than did other calcified tissue. Cesium (Cs^{134}) was not taken up to any great extent by internal soft tissues. Gills contained two to three times as much Cs^{134} relative to bathing solution as did gills from animals exposed to solutions containing Ca^{45} and Sr^{85}. (auth)

8491 COMPLICATIONS IN HIGH DOSE WHOLE PELVIS IRRADIATION IN FEMALE PELVIC CANCER. Paul M. Chau, Gilbert H. Fletcher, Felix N. Rutledge, and Gerald D. Dodd (Univ. of Texas, Anderson Hospital and Tumor Inst., Houston). Am. J. Roentgenol., Radium Therapy Nuclear Med., 87: 22-40(Jan. 1962).

Various types and degrees of severity of complications in the bladder, bowels, bones, and ureters were correlated with conventional techniques of radium and external irradiation in the early cases of squamous cell carcinoma of the uterine cervix and two major steps of whole pelvis high dose irradiation with 4000 and 6000 rads or more in the advanced cases. Concomitant with the experimental radiotherapeutic program, lymphadenectomy was carried out systematically and an attempt was made to eradicate residual or recurrent disease by radical surgery. If 4000 rads are delivered to the whole pelvis, followed with approximately 5500 to 6500 mgh of radium, there is a low in-

cidence of any type of complication and radical surgical procedures can be performed safely. Six thousand rads whole pelvis irradiation and, occasionally, for the very advanced cases, 7000 or 8000 rads can also be used, but surgical procedures can be contemplated only if there is evident residual or recurrent cancer. Additional elective procedures are not justified as the incidence of severe complications amounts to approximately 20% in patients submitted to radical irradiation and radical surgery. There were no skin complications of even minor degree. (auth)

8492 CAN RADIOSENSITIVITY AND HISTOPATHOLOGY OF CERVICAL CANCER BE CORRELATED? Arthur T. Hertig and Hazel Gore (Harvard Medical School, Boston and Free Hospital for Women, [Boston]). Am. J. Roentgenol., Radium Therapy Nuclear Med., 87: 48-55(Jan. 1962).

Various works by others are cited in an attempt to correlate radiosensitivity and histopathology of cervical cancer. The problem is complicated since radiosensitivity does not necessarily mean radiocurability. Discussion is also given on whether the exclusive treatment of cancer of the cervix by radiotherapeutic methods should be continued or whether it should be combined with some other form of therapy, or in some instances be completely replaced by surgical therapy. Stromal changes, which occur in response to irradiation, are also discussed. It was concluded that there is no uniform agreement as to whether or not histologic examination is of value in determining the form of therapy that should be employed in patients with cervical cancer. (P.C.H.)

8493 RADIOSENSITIVITY TESTING OF CERVIX CANCER BY THE TEST DOSE TECHNIQUE. S. B. Gusberg and Grace G. Herman (Columbia Univ. New York; Sloane Hospital for Women [New York] and Columbia-Presbyterian Medical Center, New York). Am. J. Roentgenol., Radium Therapy Nuclear Med., 87: 60-8(Jan. 1962).

A test dose technique for radiosensitivity testing of cervix cancer is presented, and its cytomorphologic and cytochemical appraisal is discussed. The testing studies are based, in general, on the exploitation of the greater sensitivity to irradiation of the reproductive apparatus of the cell, the chromosomes, or DNA. These studies enabled a 70% prognostic accuracy rate in cervical cancers tested, and the method was adopted for the choice of treatment in Stage I and Stage II patients. (P.C.H.)

8494 OLEIC ACID I^{131} INTESTINAL ABSORPTION IN PELVIC COBALT 60 IRRADIATION. Jack K. Goodrich and Bernard T. Hickman (Univ. of Mississippi Medical Center, Jackson). Am. J. Roentgenol., Radium Therapy Nuclear Med., 87: 69-75(Jan. 1962).

Periodic oleic acid I^{131} intestinal absorption studies were carried out at pre-planned intervals during the course of pelvic irradiation of 48 patients having a diagnosis of carcinoma of the cervix. Twenty-one of these patients, followed for a period of eight weeks after cobalt 60 irradiation, provided follow-up studies. Evaluation of these absorption studies indicates that a very low incidence of depression to abnormal levels occurs during therapy, at completion of treatment, or at eight weeks after cobalt 60 irradiation. These findings appear somewhat contrary to those in the majority of earlier reports. It is hypothesized that this negative finding may be related to the tissue sparing effect of cobalt-60 gamma radiation as compared to the effects of the heterogeneous beam generated by orthovoltage equipment and utilized in prior clinical studies. (auth)

8495 THE MEASUREMENT OF BUILD-UP ON CURVED SURFACES EXPOSED TO Co^{60} AND Cs^{137} BEAMS. R. S. Bush and H. E. Johns (Univ. of Toronto). Am. J. Roentgenol., Radium Therapy Nuclear Med., 87: 89-93(Jan. 1962).

To investigate the relative advantages of bolus versus no bolus, extensive measurements were made of the dose distribution in the superficial layers for single and parallel opposing fields applied to a phantom shaped like a chest wall. The findings indicate that for Co^{60} optimum distributions are obtained using full bolus, while for Cs^{137} bolus should only be used for half of the treatment series. A better distribution can be obtained using Co^{60} in this way than can be achieved with Cs^{137}. (P.C.H.)

8496 ACTINOMYCIN D AND RADIATION THERAPY. Edwin J. Liebner (Univ. of Chicago). Am. J. Roentgenol., Radium Therapy Nuclear Med., 87: 94-105(Jan. 1962).

Increased skin effect of radiation induced by actinomycin D was demonstrated on Sprague Dawley rats weighing approximately 0.25 kg each. Skin tests were also made on patients. Adult patients regularly showed skin effects while receiving 1 mg a day for five days. It is suggested that hypersensitivity to the drug may be contributing factor, and that a definite time interval between the administration of the drug and the subsequent irradiation be observed. Skin changes are more readily produced if actinomycin D is given intravenously two to four hours preceding the irradiation. It is also suggested that no adhesive dressings be used when a child is on actinomycin D therapy. From tissue culture and protein determinations, it appears best to give the drug every other day, trying to extend the administration as long as possible during the course of the radiotherapy. At present, there is nothing to indicate that total radiation dosages should be lowered, except temporarily during episodes of skin reactions or mild neutropenia if large fields are used. (P.C.H.)

8497 CLINICAL AND BIOLOGIC STUDIES OF ACTINOMYCIN D AND ROENTGEN IRRADIATION. Giulio J. D'Angio (Children's Cancer Research Foundation, Boston, Children's Medical Center, and Harvard Medical School, Boston). Am. J. Roentgenol., Radium Therapy Nuclear Med., 87: 106-9(Jan. 1962).

X-ray effects in normal and neoplastic tissues of mice were found to be enhanced by actinomycin D. In humans, skin and mucous membranes sometimes react earlier and more strongly to combined treatment than to comparable doses of roentgen rays alone. Actinomycin D alone may reactivate latent radiation effects in skin which was previously irradiated but which returned to a normal appearance. Encouraging results using combination therapy were obtained in children with widespread metastases from Wilms' tumor. The roentgen therapeutic aspects of their management are discussed. (auth)

8498 MEDICAL SCINTILLATION SCANNING UTILIZING CLOSED CIRCUIT TV CONTRAST ENHANCEMENT. TECHNICAL ASPECTS. William H. Fleming, James D. McIlraith, and E. Richard King (U. S. Naval Hospital, Bethesda, Md.). Am. J. Roentgenol., Radium Therapy Nuclear Med., 87: 128-40(Jan. 1962).

Technical details of photoscanning various body organs such as the brain, heart, thyroid gland, liver, spleen, kidney, and bones are discussed. All organs may be scanned except the pancreas. Closed circuit television by enhanced contrast proved a valuable adjunct to available commercial photoscanning equipment. With medical photoscanning, an atraumatic evaluation of body organs can be accomplished without morbidity or mortality. (P.C.H.)

8499 THE USE OF I^{125} TO INCREASE ISOTOPE SCANNING RESOLUTION. Harold Endlich, Paul Harper, Robert Beck, Warren Siemens, and Katherine Lathrop

(Argonne Cancer Research Hospital, Chicago and Univ. of Chicago). Am. J. Roentgenol., Radium Therapy Nuclear Med., 87: 148-55(Jan. 1962).

Experimental and clinical studies demonstrated that I^{125} may be substituted for I^{131} for liver and thyroid scanning with considerable advantage. The radiation dose to the patient may be reduced, the resolution and contrast of the scan increased, and the advantage of the long shelf life of the isotope may be enjoyed even without special detection equipment. When such equipment is used, the sensitivity of detection may be increased by an order of magnitude over that of available commercial scanning devices using I^{131}. (auth)

8500 AN INSTRUMENTED PHANTOM SYSTEM FOR ANALOG COMPUTATION OF TREATMENT PLANS. Samuel W. Alderson (Alderson Research Labs., Inc., New York), Lawrence H. Lanzl, Marvin Rollins, and Jack Spira. Am. J. Roentgenol., Radium Therapy Nuclear Med., 87: 185-95(Jan. 1962).

Realistic phantoms, molded of accurate tissue-equivalent materials, and containing natural skeletons, lungs, and other structures, were integrated with ion chamber and film dosimetry systems. The objective is to reproduce patients in sufficient detail to test and correct treatment plans by analog methods, thereafter transferring such treatments to the patient. By continued research and development into patient-phantom correspondence, a considerable contribution to improved accuracy in radiotherapy is anticipated. Treatment computation may be bypassed by analog dosimetry, and the possibility of achieving extensive and practical treatment atlases is considered. (auth)

8501 METABOLISM STUDIES BY RADIORESPIROMETRY. Chih H. Wang (Oregon State Univ., [Corvallis]). Atomlight, No. 21, 1-14(Jan. 1962).

With the adaptation of liquid scintillation counting techniques, the radiospirometric method is a useful tool in probing the nature of carbohydrate catabolism in a biological system. Estimation of pathway participation can be readily made when glucose is catabolized by the biological system via two concurrent pathways, such as the EMP and HMP pathways, making use of the cumulative $C^{14}O_2$ data observed in the radiorespirometric experiment. The simplicity of the method makes it a useful tool to survey the catabolic mechanisms in a great variety of biological systems and to study the effect of inhibitors or stimulants upon carbohydrate catabolism. (auth)

8502 METAL CARCINOGENESIS. I. OBSERVATIONS ON THE CARCINOGENICITY OF A REFINERY DUST, COBALT OXIDE, AND COLLOIDAL THORIUM DIOXIDE. J. P. W. Gilman and G. M. Ruckerbauer (Ontario Veterinary Coll., Guelph, Ont.). Cancer Research, 22: 152-7(Feb. 1962).

A metallurgical dust obtained from the dust flue of a nickel refinery was shown to be a locally acting carcinogen in both rats and mice. Sarcomas were induced in two strains of rats at about 45% of the sites of intramuscular injection, with most of the tumors being demonstrably of striated muscle cell origin. Average latent periods approximated 6 months, and metastases occurred frequently. Mice proved less responsive than rats, showing significantly longer latent periods and an absence of metastases. A majority of the mouse tumors appeared to be fibrosarcomas. Similar experiments utilizing single intramuscular injections of cobalt oxide powder gave a 50% local incidence of rhabdomyosarcomas in rats but proved completely negative in the mice tested. Single intramuscular injections of Thorotrast failed to induce a local tumor response in either rats or mice. Four out of 50 Thorotrast-treated mice developed malignant lymphomas in an average of 457 days. No sarcomas or malignant lymphomas were observed in control animals given injections of Procaine Penicillin G. (auth)

8503 METAL CARCINOGENESIS. II. A STUDY ON THE CARCINOGENIC ACTIVITY OF COBALT, COPPER, IRON, AND NICKEL COMPOUNDS. J. P. W. Gilman (Ontario Veterinary Coll., Guelph, Ont.). Cancer Research, 22: 158-62(Feb. 1962).

Nickel sulfide, nickel oxide, cobalt sulfide, and cobalt oxide were shown to be carcinogenic on single intramuscular injection in rats. The sulfide of each metal induced a significantly higher tumor incidence than did its oxide. Comparisons between average latent periods and between measures of tumor progression also indicated that the presence of the sulfide enhances the carcinogenic activity of these compounds. Nickel sulfate, iron and copper sulfides, and oxides failed to induce tumors in rats under these conditions. Both C3H and Swiss mice developed tumors from single intramuscular exposure to Ni_3S_2 and to NiO; however, no tumors were induced with CoO in this species. Tumor response in mice was consistently lower than in rats, and no apparent enhancing effect of the sulfide was evidenced. In rats, almost all tumors examined histologically were rhabdomyosarcomas, with a few fibrosarcomas, particularly among those tumors induced with NiO. Difficulty was encountered in definitely classifying the mouse tumors; whereas most appeared to be fibrosarcomas, many of these were not typical, and a few were almost certainly myomas. It was concluded that nickel sulfide was probably the compound responsible for the carcinogenic activity of the sample of metallurgical dust originally investigated (collected from the dust flue of a nickel refinery). The apparent specificity of nickel and cobalt compounds for striated muscle tumorigenesis is discussed. (auth)

8504 PLUTONIUM INHALATION STUDIES. I. THE RETENTION AND TRANSLOCATION OF INHALED $Pu^{239}O_2$ PARTICLES IN MICE. W. J. Bair, D. H. Willard, and L. A. Temple (General Electric Co., Richland, Wash.). Health Phys., 7: Nos. 1 and 2, 54-60(Dec. 1961).

Mice exposed to $Pu^{239}O_2$ aerosols deposited about 20% of the amount inhaled in lungs. From 40 to 60% was distributed between the nasal and oral passages and the gastrointestinal tract. Although the major portion of the body burden was associated with the lung during a 70 week period there was gradual translocation to the skeleton, muscle, liver, and spleen. The skeleton accumulated the largest quantity of translocated Pu^{239}, about 0.3% of the total dose. This was equal to the amount remaining in lung. The half life for clearance of about 4% of the Pu^{239} initially deposited in lung was 460 days. The remainder was cleared with half lives of 20 days or less. Assuming uniform distribution after deposition of 0.02 μc Pu^{239} in lung, the total α-dose to mouse lung tissue during the 70-week period was 550 rad. (auth)

8505 SECRETION OF CALCIUM AND STRONTIUM INTO MILK. C. L. Comar, R. H. Wasserman, and A. R. Twardock (New York State Veterinary Coll., Ithaca). Health Phys., 7: Nos. 1 and 2, 69-80(Dec. 1961).

The comparative secretion of Ca^{45} and Sr^{89} into the milk of goats and dairy cows under typical farm management was studied. The effects of calcium and stable strontium levels were investigated by using four diets containing 0.25% Ca, 0.50% Ca, 1.6-1.7% Ca, and 0.25% Ca plus 2.8-2.9% stable strontium. The comparative behavior of calci-

um and strontium was the same on all diets except for a possible renal effect with the goats. The Sr^{89}/Ca^{45} of the milk was consistently about 0.12 that of the dietary intake ($OR_{milk-diet} = 0.12$). The relative contributions to the discrimination against strontium were estimated for the important physiological processes, such as absorption from the digestive tract, passage from blood to milk, and renal excretion. On the medium-calcium diet at steady state the dairy cows secreted into milk about 0.08% of the ingested Sr^{89} per liter; the goats, primarily because of body size, secreted much more, about 1.4% of ingested Sr^{89} per liter of milk. Since the $OR_{diet-milk}$ value did not vary with changes in dietary calcium levels it would be expected that long-term feeding of increased dietary levels of noncontaminated calcium would produce proportional decreases in the amounts of ingested radiostrontium appearing in milk; there would seem to be no advantage in the use of stable strontium for this purpose. Practical aspects are discussed. (auth)

8506 LOW-LEVEL POLONIUM AND RADIOLEAD ANALYSIS. Stuart C. Black (Univ. of Rochester, N. Y.). Health Phys., 7: Nos. 1 and 2, 87-91(Dec. 1961).

Methods are described for low-level Po^{210} and Pb^{210} analysis of amounts up to 1 liter of urine, 10-20 g of bone, 50-60 g tissue. The methods are applied to the analysis of experimental animals exposed to natural levels of radon and its short-lived daughters, yielding a natural Po whole-body content of about 5×10^{-15} c/g. When the experimental animals are exposed to elevated daughter-free radon atmospheres, the Po and Pb body contents are increased. The study is part of a program to explore the usefulness of measurements of the Po content of miners' urine as an indicator of the integrated dose from radon and its daughters. (auth)

8507 PREPARATION OF HIGH SPECIFIC ACTIVITY GLUCAGON I^{131}. M. S. McCall, D. L. Timm, A. M. Eisentraut, and R. H. Unger (Veterans Administration Hospital, Dallas and Univ. of Texas Southwestern Medical School, Dallas). J. Lab. Clin. Med., 59: 351-6(Feb. 1962).

A simple, rapid, and reliable method for radioiodination of glucagon is described. By this technique, 12 to 28% of the I^{131} was incorporated in the protein and specific activities of approximately 200 mc per milligram were obtained. The entire procedure, which could be completed within 4 hours, usually yielded a product of which 93 to 99% was identified chromatographically as undamaged glucagon I^{131}. (auth)

8508 THE DISCRIMINATION BETWEEN NATURALLY INCORPORATED Sr^{89} AND Ca^{45} AS STUDIED BY A FEEDING EXPERIMENT WITH MICE. Bertil Rasmuson and Bo Gahne (Inst. of Plant Systematics and Genetics, Uppsala and Research Inst. of National Defence, Uppsala). Kgl. Lantbruks-Högskol. Ann., 27: 323-333(1961). (In English)

Six different diets were tested in a feeding experiment with mice with a duration of 19 days. Five of these contained Sr^{89} and Ca^{45} incorporated in the green material of red clover, peas, oats, timothy, and spinach, and one contained non-radioactive red clover with Sr^{89} and Ca^{45} added in solution. No extra Ca and Sr was added to the diet. The radioactivity was measured in feces and urine from the last 8 days of the experiment and in the bodies of the mice after cremation at the end of the experiment. The retention was estimated from the body analysis as well as from the balance data. The availability of Ca and Sr in the green material from peas and timothy was found to be less than in that from red clover and oats. However, the data for oats are somewhat doubtful. The spinach diet was unsuitable for the mice, since both Ca and Sr were very unavailable in this plant. In all diets except that containing spinach there was a discrimination against Sr in the retention as compared with Ca. The $OR_{body-diet}$ was about 0.3. No significant difference in availability was found when Ca and Sr were incorporated in the green material of the red clover and when it was added in solution to the diet. (auth)

8509 PHYSIOLOGICAL AND PATHO-HISTOLOGICAL EVALUATION OF THE INFLUENCE OF RADIOACTIVE PHOSPHORUS ON VARIOUS ORGANS, ESPECIALLY ON LIVER FUNCTION. I. Kurita (Nagoya Univ. School of Medicine, Japan). Nagoya Igaku, 79: 1743(1959).

The influence of P^{32} on various organs was evaluated by changes in RBC, WBC, hemoglobin, serum protein, protein fractions, iron and glucose metabolism, and liver function. The disturbance of liver function was proportional to the amount of P^{32} injected, being slight with 12 μc/kg, moderate with 60 μc/kg and very severe with 120 μc/kg. The effect of P^{32} on serum protein was slight. Histological changes following P^{32} injection were: nuclear degeneration, decrease in PAS-positive substance, iron phagocytosis by Kuppfer's cells, presence of fine fat granules, and cellular atrophy. The clinical use of Takata's liver function test is recommended to evaluate the effects of P^{32}, because the pathological changes caused by P^{32} corresponded well with the results of Takata's test. (Abstr. Japan Med., 1: No. 15, 1961)

8510 RADIOACTIVITY IN SNAIL SHELLS DUE TO FALL-OUT. E. Sándi (Inst. of Nutrition, Budapest). Nature, 193: 290(Jan. 20, 1962).

Specimens of the snail, Helix pomatia, were investigated for contamination due to Sr^{90}. Shells of adult animals had an ash content of 96 to 98% containing 95 to 98% $CaCO_3$. The Sr^{90} activity varied from <5 to 63 $\mu\mu$c/g. Correlation between the type of soil and the Sr^{90} activity of the shells was evident. (M.C.G.)

8511 THE INTERPRETATION OF SCINTIGRAMS OF THYROID TUMOURS. Y. Nishikawa (Ito Hospital, Tokyo). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2073-93(1960).

Scintigrams of thyroid tumors were taken following the administration of I^{131} in 163 patients. A negative image of the nodules, defects of image on one side, or a deformed defect of image of the lobe of the thyroid were seen on the scintigram when the tumors were malignant. An enlarged image of the lobes was found in benign tumors. When the scintigraphic image of nodules, the so-called hot nodules, was positive it was an indication of a benign tumor. (Abstr. Japan Med., 1: No. 15, 1961)

8512 STUDIES OF THE INFLUENCE OF X-RAY THERAPY ON THE FUNCTION OF ADRENAL CORTEX. I. STUDIES OF URINARY 17-KS. N. Agari (Toho Univ. School of Medicine, Tokyo). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2494-2502(1961).

Changes in the adrenal function of patients receiving radiotherapy were examined. For the measurement of 17-KS, the Zimmermann-Masuda modification method was used. Considerable changes of the 17-KS content in the urine were observed after irradiation. The 17-KS content varies immediately after irradiation and is largely related to the grade of radiation sickness. Even when small doses were administered intermittently the 17-KS content was increased. This was considered to be due to adrenal hypofunction. (Abstr. Japan Med., 1: No. 15, 1961)

8513 STUDIES OF THE INFLUENCE OF X-RAY THERAPY ON THE FUNCTION OF ADRENAL CORTEX. II. STUDIES OF URINARY AND BLOOD 17 OH-CS. N. Agari (Toho Univ. School of Medicine, Tokyo). Nip-

pon Igaku Hoshasen Gakkai Zasshi, 20: 2503-12(1961).

A slight increase of the 17 OH-CS content in the blood was immediately observed 1 hr after irradiation, and a gradual increase 2 hr after irradiation. A temporary decrease of the eosinophile leukocyte counts in the peripheral blood was also observed during this time. From 2 days to one week after irradiation the 17 OH-CS contents showed a gradual decrease. This was considered to be due to exhaustion of the suprarenal system. (Abstr. Japan Med., 1: No. 15, 1961)

8514 INFLUENCE OF X-RAY THERAPY UPON THE THROMBOPOIETIC SYSTEM. S. Takanshi (Toho Univ. School of Medicine, Tokyo). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2513-21(1961).

Twenty-two patients treated by fractionated superficial irradiation of small doses, from 30 to 50 r for lymphadenitis tuberculosa and peritonitis tuberculosa, and 46 patients treated by high daily deep irradiation doses of 200–250 r for malignant tumors were studied. In the high dosage group, an increase of the platelet count was occasionally observed at the beginning of the irradiation. None of the cases showed a decrease in the megakaryocyte count, but a marked increase was frequently observed. In the group treated by small dosage fractionated irradiation, a slight decrease in thrombopoiesis was revealed even when the total dosage was 1000 r. In the group treated by deep irradiation, however, no decrease was revealed in thrombopoiesis even after a total dosage of 1000-2000 r. It is concluded that the thrombopoietic sensitivity of the megakaryocytes may be affected by deep x-ray therapy. (Abstr. Japan Med., 1: No. 15, 1961)

8515 REACTION OF THE HEART TO THERAPEUTIC IRRADIATION WITH SPECIAL REFERENCE TO RADIATION PERICARDITIS'. Y. Kanetake (Gifu Prefectural Medical Univ., Gifu, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2707-22(1961).

A definite increase in the transverse diameter of the cardiac silhouettes was seen occasionally in 3 out of 17 irradiated patients. Angiocardiograms in frontal projection revealed an abnormally wide cardiac wall bilaterally, which indicated the presence of pericardial effusion, probably due to the irradiation. Experimentally, normal adult rabbits were irradiated with various doses of roentgen rays, ranging from 500 to 3000 r. Post-mortem examination revealed both pericardial and pleural effusions in addition to radiation pneumonitis. (Abstr. Japan Med., 1: No. 15, 1961)

8516 ESTIMATION OF BODY BURDEN OF EXCRETION ANALYSIS. Minoru Fujita and Junko Iwamoto (Japan Atomic Energy Research Inst., Tokyo). Radioisotopes (Tokyo), 10: 310-21(Sept. 1961). (In Japanese)

Formulas which correlate the contents of radioisotopes eliminated in excreta with those retained in the body were studied. The formulas were derived on the basis of the standard man and the exponential function model in ICRP. It was assumed in the case of inhalation of insoluble compounds, that they would behave as soluble compounds after being taken up from the lungs by body fluids. For the estimation of body burden by excretion analysis, consideration was given to chronic exposure of soluble and insoluble compounds and to single exposure of soluble and insoluble compounds. Permissible concentration in urine was calculated for several kinds of radioisotopes. In this calculation, permissible dose rates of ICRP were given as the basis of the calculation, and then body burdens corresponding to those dose rates were determined. The permissible amounts of the radioisotopes eliminated in the excreta were obtained from the body burdens by making use of the formulas derived. The results of the calculation are shown. (N.W.R.)

8517 STUDY OF I^{131}-ADSORPTION AT HUMAN TEETH NECK. Tomomitu Higashi, Sigetaka Suzuki, Fumio Nakayama, and Motoo Yaba (Nippon Dental Coll., Tokyo). Radioisotopes (Tokyo), 10: 329-33(Sept. 1961). (In Japanese)

The order of iodine-131 adsorption at the necks of human teeth is: (alveolar pyorrhea = P_3) $P_3 > P_2 > P_1 >$ normal. At first the iodine disappears very rapidly (1st stage), and then gradually decreases (2nd stage). The disappearance of the 2nd stage is formulated by the expression, $y = Ae^{-\alpha t}$, α is the decay coefficient. The α-value of a patient suffering from alveolar pyorrhea complicated with gingivitis and having dental deposits on the teeth is very high, and that of patients having undergone gingivectomy is low and normal. (N.W.R.)

8518 A NEW DEVICE OF QUANTITATIVE EVALUATION METHOD IN FUNCTION TEST OF ORGAN WITH USE OF RADIOISOTOPES (EXTERNAL COUNTING TECHNIQUE). Kin-ichi Hisada (Kanazawa Univ., Japan). Radioisotopes (Tokyo), 10: 334-41(Sept. 1961). (In Japanese)

From physiological and mathematical considerations, an evaluation method is devised that will describe the function of various organs being tested with radioactive labeled compounds quite objectively. The method, an external counting technique, is based on hepatogram curves, in particular the amplitude of the curves. The method allows the uptake speed of radioactive compound into the organ cells as well as its excretion speed to be calculated. Quantitative considerations, practical procedure of quantitative evaluation, and limits of applicability are discussed. (N.W.R.)

8519 FUNDAMENTAL STUDIES OF ACTUAL-SIZE-SCINTIGRAM. Goro Kusumoto, Yoshio Onai, and Teizo Tomaru (Hospital of Cancer Inst., [Tokyo]). Radioisotopes (Tokyo), 10: 342-8(Sept. 1961). (In Japanese)

An actual-size scintigram of a thyroid gland was obtained using five different iodine-131 source shapes. The cps of every point are expressed as a percentage of the maximum counts of the source. By adjusting the background cut-off circuit to the optimum cps (%) of each source, the actual-size scintigram is obtained. Optimum cps (%) are as follows: 37.5 mm diam sphere 30%; 37.5 mm diam by 1 mm thick disk 60%; 37.5 mm diam by 11 mm thick disk 60%; 40 mm by 20 mm by 10 mm cuboid 60%; and human thyroid 40%. Drawing iso-cps (%) lines of each source, it is found that the line shapes are similar to the outline of the source; their distribution and shape are independent of source intensity. In the clinic, iso-cps (%) lines are convenient for establishing the distribution of iodine-131, and particularly for locating a thyroid tumor. (N.W.R.)

8520 THE ANALYSIS OF THE LIVERSCANNING (1st REPORT). Ichiro Kuramitsu, Hisao Shibata, Kozi Tottori, and Motoyuki Kikkawa (Second Tokyo National Hospital). Radioisotopes (Tokyo), 10: 349-60(Sept. 1961). (In Japanese)

Liver scanning, using both colloidal gold-198 and needle biopsy, was studied in order to find whether these methods are suitable for the prognosis of various liver diseases. In the case of hepatoma, the scintigram of the liver shows defective figures while the liver function remains almost normal. In the cases of cirrhosis, there are times when a normal liver scintigram is shown in spite of the liver dis-

order. When the cirrhosis does show on the scintigram, it is due to misinterpretation. On the other hand, scintigrams for needle biopsy are very helpful in diagnosing some liver diseases. The correlation of liver parenchyma and the reticuloendothelial system in the liver was studied, and it was found that injury of the reticuloendothelial system confirms the disorder of the function of liver parenchyma. (N.W.R.)

Fallout and Ecology

8521 THE INFLUENCE OF THE OSMOTIC PRESSURE OF A NUTRIENT SOLUTION ON PHOSPHORUS UPTAKE THROUGH THE ROOTS OF LYCOPERSICON ESCULENTUM. H. Linser, H. H. Mayr, and C. Chwala (Osterreichische Stickstoffwerke A. G., Linz/Donau). Atompraxis, 8: 4-6(Jan. 1962). (In German)

Tomato plants in a nutrient solution were exposed to various osmotic pressures (produced by adding mannite) for 4 hours, and the uptake of P^{32} in the above-ground organs during this time was quantitatively determined. In the range from 0.0 to 0.1 mole of mannite there was a slight quantitative decrease in uptake, with a marked decrease in the range from 0.1 to 0.3 mole. Border plasmolysis was not observed until osmotic pressures were reached at which the uptake of P^{32} had decreased to $\frac{1}{3}$ of the original value. (auth)

Radiation Effects on Living Tissues

8522 (ACRH-16) SEMIANNUAL REPORT [ON MEDICAL RESEARCH] TO THE ATOMIC ENERGY COMMISSION, SEPTEMBER 1961. Leon O. Jacobson, ed. (Argonne Cancer Research Hospital, Chicago). Contract AT(11-1)-69. 154p.

Separate abstracts were prepared on the 12 sections of this report. Abstracts covering 4 sections have previously appeared in NSA. A list is included of staff publications during the period covered by this report. (C.H.)

8523 (ACRH-16(p.12-22)) FOCAL IONIZING RADIATION OF THE POSTERIOR OCULAR SEGMENT. F. W. Newell, O. Choi, N. A. Book, A. Simkus (Chicago. Univ.), and P. V. Harper (Argonne Cancer Research Hospital, Chicago).

Summary of Paper Published in Am. J. Opthalmol., 50: 1215-25(Dec. 1960).

Data are reviewed concerning the effects of focal ionizing irradiation of the posterior ocular segment in the treatment of intraocular malignancy. Polyethylene envelopes were attached to the sclera of rabbits and then filled with I^{131} of different activities. The effects of the radiation were studied ophthalmoscopically and histologically at various intervals after the implantation. Dosage factors used are tabulated and calculated isodose curves are presented showing γ ray dosage surrounding a 1.0 cm^2 plane applicator containing 1.0 mc I^{131}, assuming complete decay, inverse square attenuation, and no absorption. Calculated γ radiation levels are also presented for one mc of Ra, Rn, Co^{60}, Au^{198}, I^{131}, Ir^{192}, and Ta^{182}. It is concluded that focal ionizing radiation with I^{131} will give results comparable with those obtained previously with Ra, Co^{60}, or Rn applicators in the treatment of certain eye malignancies. The chief advantage in the use of I^{131} is in permanent placement of the implant so that it does not have to be removed. It is believed that a concentration of 2.0 mc/cm^2 of I^{131} should be used with appropriate precaution so that the implant is in close contact with the sclera overlying the area to be treated. (C.H.)

8524 (ACRH-16(p.23-40)) THE PATHOGENESIS OF GOUT. L. B. Soerensen (Argonne Cancer Research Hospital, Chicago).

Uric acid and glycine labeled with C^{14} were used in measurements of the miscible pool and turnover rate of uric acid in gouty patients. The miscible pool is defined as the quantity of urates in the body capable of mixing promptly with intravenously-injected isotope-labeled uric acid. The miscible pool averages about 1200 mg in normal males, the turnover rate is a measure of the fraction of all the uric acid which is replaced per unit time. The endogenous urate production amounts from 600 to 700 mg/day in health males. The metabolism of uric acid is outlined diagrammatically, and a scheme is presented showing the characteristics of both primary and secondary gout. Abstracts of cases in each group are presented as well as results of tracer studies. Results indicate that an excessive intake of purines does not ordinarily play any role in the pathogenesis of gout and neither does extrarenal elimination play a role in the development of hyperuricemia. The case history is included of a patient who developed acute gouty arthritis following the administration of chlorothiazide for the treatment of hypertensive cardiovascular disease. Results of tracer studies indicate that small doses of this drug inhibit the tubular excretory mechanism for urate, resulting in retention of urate. When larger doses are given, tubular reabsorption of urate is also suppressed, resulting in uricosuria. (C.H.)

8525 ROENTGEN DIAGNOSIS OF PANCREATIC DISEASE. R. D. Moseley, Jr. (Argonne Cancer Research Hospital, Chicago). A.M.A. Arch. Internal Med., 107: 31-6 (Jan. 1961). (ACRH-16(p.41-9)).

Procedures for the radiologic investigation of the pancreas are reviewed. Substances currently under investigation for direct visualization of the pancreas ranging from acridine compounds to zinc compounds are tabulated. These compounds were selected on the basis of experimental evidence of selective excretion by the pancreas and on the possibility of altering these compounds, usually by the substitution of iodine atoms, in order to make them opaque to x rays. It is concluded that until these compounds are available, radiologic diagnosis of pancreatic disease will rest on presently available, though often unsatisfactory techniques, of gastroduodenal examinations, operative pancreatography, pancreatic angiography, pneumoretroperitoneal pancreatography, intravenous cholangiography, percutaneous direct cholangiography, and splenoportography. (C.H.)

8526 (ACRH-16(p.50-3)) DETERMINATION OF RADIOTRACER STABILITY OF TRITIUM-LABELED COMPOUNDS IN BIOLOGICAL STUDIES. G. T. Okita (Argonne Cancer Research Hospital, Chicago) and J. L. Spratt (Chicago. Univ.).

Presented at the International Atomic Energy Agency Symposium on the Detection and Use of Tritium in the Physical and Biological Sciences, Vienna, Austria, May 1961.

Methods are described for use in establishing the radiotracer stability of tritiated compounds. The necessity is stressed of establishing biologic radiotracer stability of tritiated compounds which are to be employed in biological investigations since the possibility exists that tritium atoms may exchange with hydrogen atoms when tritium-labeled compounds are used in biological studies. (C.H.)

8527 (ACRH-16(p.54-61)) IN VIVO BIOCHEMICAL CHANGES DURING SPONTANEOUS CARCINOGENESIS. I. METABOLIC PATTERNS OF EXPIRATORY $C^{14}O_2$ FOLLOWING ADMINISTRATION OF BICARBONATE, ACE-

TATE AND GLUCOSE. E. A. Ezz and G. T. Okita (Argonne Cancer Research Hospital, Chicago).

Results are reported from an attempt to evaluate possible biochemical changes occurring during the process of spontaneous carcinogenesis as well as during tumor development in intact unanesthesized animals. These changes were investigated by following expiratory $C^{14}O_2$ patterns in normal, precancerous, and tumor-bearing animals following the administration of C^{14}-labeled intermediates to mice of high cancer strain which develop spontaneous mammary tumors. Data are tabulated on the bicarbonate pool size, half-time, and turnover rates of the miscible body carbonate pool for the various experimental groups. Differential expiratory $C^{14}O_2$ curves are presented following the administration of sodium bicarbonate-C^{14}, sodium acetate-1-C^{14}, glucose-1-C^{14}, and glucose-6-C^{14} to the various experimental groups. Data are tabulated on the per cent of the injected dose recovered over the experimental period. Significant biochemical changes noted in the three groups of animals are summarized. (C.H.)

8528 URIDINE NUCLEOTIDE INCORPORATION INTO PIGEON LIVER MICROSOME RIBONUCLEIC ACID. D. B. Straus and E. Goldwasser (Argonne Cancer Research Hospital, Chicago). J. Biol. Chem., 236: 849-56(Jan. 1961). (ACRH-16(p.62-78)).

Results of experiments on pigeon liver cytoplasmic fractions are reported that show that desoxyribonucleic acid (RNA) synthesis occurs in the microsome fraction. The conditions required for nucleotide incorporation into pigeon liver microsomal RNA were determined and a comparison made between uridine monophosphate, uridine diphosphate, and uridine triphosphate (UTP) as RNA precursors using C^{14}-labeled nucleotides characterized spectrophotometrically and by chromatography with authentic standards. Radioautograms of the chromatograms were made. The zero time binding of UTP to the various subcellular fractions from pigeon liver and of all three uridine nucleotides to microsomes was measured and results are tabulated. Reaction mechanisms involved are discussed. (C.H.)

8529 ON THE PARTICIPATION OF DNA IN RNA BIOSYNTHESIS. S. B. Weiss and T. Nakamoto (Argonne Cancer Research Hospital, Chicago). Proc. Natl. Acad. Sci. U.S., 47: 694-7(May 1961). (ACRH-16(p.79-83)).

Investigations were made of an enzyme system from extracts of the microorganism M. lysodeikticus that requires 4 ribonucleoside triphosphates for the incorporation of ribonucleotides into RNA. In order to obtain some insight into the role played by DNA in this reaction, nearest neighbor sequence analysis and base composition of the newly synthesized RNA were determined for a number of different primer DNA's. RNA prepared enzymatically with one P^{32}-nucleotide was used to examine the relative frequency with which the labeled nucleotide occurred next to a given neighbor. Examination of the results obtained when calf thymus, rat liver, or different bacterial DNA's serve as primers in separate reactions, suggested that the relative position of labeled cytidylate in the newly formed RNA is different for the various primers used. Tabulated data compare the base composition of synthesized RNA as compared to primer DNA. (C.H.)

8530 (ACRH-16(p.84-93)) STUDIES ON IRON ABSORPTION. I. THE RELATIONSHIPS BETWEEN THE RATE OF ERYTHROPOIESIS, HYPOXIA AND IRON ABSORPTION. G. A. Mendel (Argonne Cancer Research Hospital, Chicago).

The relationship between the rate of red cell production, hypoxia, and the gastrointestinal absorption of Fe was investigated in mice. Iron incorporation into circulating red blood cells was determined following injection of Fe^{59}. Splenectomy and Sr^{89} were used to produce erythropoietic suppression. Results indicate that the mechanism by which erythropoietin augments Fe absorption is dependent on acceleration of erythropoiesis rather than a direct action of the hormone on the gastrointestinal mucosa. Iron absorption in hypoxic animals was greatly enhanced in the presence of profound suppression of erythropoiesis and without experimental manipulation likely to alter total-body iron content. This emphasizes the existence and importance of factors influencing absorption that are independent of accelerated erythropoiesis and total-body Fe content. The data clearly indicate that increased Fe absorption due to hypoxia can occur independently of acceleration of erythropoiesis. (C.H.)

8531 (ACRH-16(p.120-5)) USE OF A HETEROGENEOUS PHANTOM WITH A LINEAR ACCELERATOR. L. H. Lanzl (Argonne Cancer Research Hospital, Chicago).

The use of a homogeneous phantom, constructed of elliptical masonite slabs 1 cm thick and having major and minor axes of 34 and 24 cm respectively, with Eastman Kodak Industrial AA photographic film as a detector, in radiation dosage determinations from a linear accelerator is described. The blackening of the film serves as an indicator of the dose. It was found that there is a linear relationship between exposure and net optical density of the film for doses of electrons from 5 to over 40 Mev. Measurements of this relationship were made by exposing the film to different doses of electron pulses, always at the same instantaneous current. The measured isodensity distribution therefore corresponded to the isodose distribution. The heterogeneous phantom, which represents the thoracic region of a patient, was loaded with film cut to shape and inserted between the sections. Isodose distributions are presented for combined arc and field therapy. (C.H.)

8532 (ACRH-16(p.126-35)) A WHOLE-BODY COUNTING FACILITY FOR BIOLOGICAL AND MEDICAL RESEARCH. D. B. Charleston (Argonne Cancer Research Hospital, Chicago).

The design and construction of a whole-body counting facility is described. A multiple-crystal detector system is described which can be used to perform compartment studies which permit the observation of as many as 5 regions of view within the body using any γ-emitting isotope from 30 kev to 500 kev. Studies have been made using 2 detectors with focusing collimators for Ca^{47}, Fe^{59}, I^{131}, and Sr^{85}. Other proposed counting programs are discussed. An analysis of the detectors and block diagram of the electronics are included. Calibration of the multiple crystal array is described. (C.H.)

8533 EFFECT OF PREGNANCY ON THE METABOLIC INFLUENCE OF ADMINISTERED PROGESTERONE. R. L. Landau (Argonne Cancer Research Hospital, Chicago), E. J. Plotz, and K. Lugibihl. J. Clin. Endocrinol. and Metabolism, 20: 1561-7(Dec. 1960). (ARCH-16(p.136-40)).

Progesterone, in a dosage of 50 to 100 mg/day, administered to 3 women during the 2nd and 3rd trimesters of pregnancy had no effect on urinary nitrogen excretion. Metabolic factors influencing the effects of progesterone during pregnancy are discussed. (C.H.)

8534 (ACRH-16(p.141-50)) NUCLEIC ACID-SPLITTING ENZYMES IN HUMAN EPIDERMIS AND THEIR POSSIBLE ROLE IN KERATINIZATION. P. Santoianni (Chicago. Univ.) and S. Rothman (Argonne Cancer Research Hospital, Chicago).

Presented at the 22nd Annual Meeting of the Society for Investigative Dermatology, June 27-29, 1961.

Desoxyribonuclease was demonstrated and quantitated in both human and rat epidermis. No desoxyribonuclease activity was found in dermis extracts. The possibility that an enzymatic process may govern the disappearance of nuclei in keratinization and the biochemical behavior of enzymes involved, if any, was investigated. The effects of NaCl, $MgSO_4$, Zn, and Cu ions, vitamin A, and x radiation on both type I and type II DNase in skin extracts were measured. Results indicate that DNase plays an important role in the decomposition of epidermal nuclei in the cornifying layers of skin. (C.H.)

8535 (AF-SAM-61-114) DEMYELINATING LESIONS AND FOCAL VASCULAR LESIONS IN THE CEREBRAL WHITE MATTER OF NORMAL AND IRRADIATED MONKEYS (MACACA MULATTA). James A. Pitcock (Texas. Univ., Austin. Radiobiological Lab.). June 19, 1961. 11p.

Issued by School of Aerospace Medicine, Brooks AFB, Tex.

The brains of irradiated and nonirradiated monkeys that died spontaneously were examined systematically. The severity of demyelinating disease and of focal vascular disease of white matter was estimated. Data on incidence and severity of these diseases as a function of age are presented. These diseases are found only in postpubertal monkeys and increase in incidence with aging. Prior irradiation may cause an increase in the incidence of demyelinating disease in older animals, but no effect was noted in the incidence of focal vascular disease of white matter. (auth)

8536 (AF-SAM-61-115) AN ELECTRON MICROSCOPIC STUDY OF ACUTE RADIATION INJURY OF THE RAT BRAIN. James A. Pitcock (Texas. Univ., Austin. Radiobiological Lab. and School of Aerospace Medicine, Brooks AFB, Tex.). June 19, 1961. 22p.

Radiation-induced central nervous system injury in the rat was studied by electron microscopic technics. Lesions were observed in cells which appeared unchanged with only light microscopic examination. Changes in the nuclear membrane could be seen rapidly after 15,000 r of Co^{60} gamma radiation were administered. Lesions of the cytoplasmic organelles and other cerebral structures were also visualized. (auth)

8537 (AMRL-504) CESIUM-137 RETENTION AND DISTRIBUTION IN X-IRRADIATED RATS. J. G. Kereiakes, D. D. Ulmer, A. T. Krebs, and T. D. Sterling (Army Medical Research Lab., Fort Knox, Ky.). Sept. 4, 1961. 22p.

The influence of external ionizing radiation on the retention and distribution of cesium-137 was studied. Immediately following a total-body exposure of 300, 600, or 900 r of 250 kv x rays, rats were injected with 1 μc cesium-137. Rats given cesium-137 only served as controls. The x-irradiated rats excreted more cesium-137 over the three-day period following the irradiation than the controls, primarily accounted for by increasing urine excretion. Rats irradiated with 900 r and injected with 5 μc cesium, sacrificed at 24 hours, retained less cesium in muscle, bone, blood, small intestine, and spleen but more in stomach and liver than the controls. Possible mechanisms are discussed. (auth)

8538 (TID-14201) SUMMARY OF PRINCIPAL ACCOMPLISHMENTS [IN RADIOBIOLOGY], JANUARY 1957 TO OCTOBER 1961. Progress Report. William H. Sweet and Gordon L. Brownell [(Massachusetts. General Hospital, Boston)]. Contracts AT(30-1)-1093 and AT(30-1)-1242. 24p.

Progress is reported in studies on the use of thermal and epithermal neutrons in the treatment of neoplasms and the external localization of brain tumors with the aid of positron-emitting radioisotopes. Active transport of normal electrolytes across membranes bounding the subarachnoid space and active transport in the region of the 4th ventricle, which removes such substances as diodrost and phenolsulfonephthalein from cerebrospinal fluid were demonstrated by tracer techniques. Improved procedures for electron microscopy were developed which led to the identification of the unit of mitochondrion. Minor technical advances improved the accuracy of positron scanning for the precise localization of tumors. Preliminary tests were completed for a positron camera. Many patients with a wide range of neurological disorders were scanned after the administration of several positron-emitting radioisotopes, such as As^{74}, Cu^{64}, and Ga^{68}, and many compounds containing these isotopes. Clinical data and results of radioisotope scanning for brain tumor localization for over 3000 patients have been reduced to a system of IBM cards. Results of a pilot study indicate that Dy^{165} may be useful in cerebral perfusion treatment of malignant tumors. Improvements are reported in techniques for the treatment of brain tumors using the boron-slow neutron capture method. Better chemical vehicles for B^{10} were developed, and a well-controlled facility was built for the safe administration of a massive slow neutron flux to the cut face of brain containing tumor. Results are summarized for 17 patients who received this treatment. A list is included of 40 publications covering work completed during the report period. (C.H.)

8539 (TID-14541) STUDIES OF THE EFFECTS OF ULTRAVIOLET RADIATION ON CELL STRUCTURES AND BEHAVIOR. Period covered: March 1959 through November 1961. Jack Schultz (Institute for Cancer Research, Philadelphia). Dec. 15, 1961. Contract AT(30-1)-2356. 71p.

Irradiation studies of living cells, using a flying-spot ultraviolet microscope, were carried out to study the nature of radiation damage artifacts, specifically the effects on cell shape and motility. These experiments suggest that the damage studied is caused by the absorption of radiation by a protein-containing material distributed rather generally throughout the cell. This material is thought to be responsible for maintaining normal cell shape and also the ability of the cell to remain attached to a substrate. A new type of flying-spot microscope, using a mechanical system for generation of the scanning pattern, was designed, constructed, and tested as a spectrophotometer for the analysis of ultraviolet absorption by living cells. It was shown to be capable of making such absorption measurements without the production of morphologically expressed radiation damage artifacts or causing losses of absorbing material. Work with cell culture systems was carried out to provide appropriate experimental material for ultraviolet microscopy. As a result of these studies, it was proved possible to cultivate haploid cells from amphibian embryos. These were used for experiments on the genetic mechanisms of somatic cells in culture. (auth)

8540 (TID-14774) RADIATION AND OTHER FACTORS INFLUENCING THE DISTRIBUTION OF ANIMALS. Progress Report and Renewal Proposal. Walter J. Breckenridge and John R. Tester (Minnesota. Univ., Minneapolis). Jan. 1962. Contract AT(11-1)-899. 18p.

Progress is reported for studies of environmental and radiation effects on three species of toads, Bufo americanus, B. cognatus, and B. hemiophrys. Controlled survival

tests in which tadpoles of B. americanus and B. hemiophrys were subjected to physical and chemical extremes indicated that B. hemiophrys is more resistant than B. americanus. The status of the subprojects on factors influencing toad survival during hibernation and irradiation of dormant toads is outlined. A soil simulator was built for studying the burrowing behavior of toads. (D.L.C.)

8541 (TID-14809) RECOVERY FROM RADIATION-INDUCED DIVISION BLOCK IN PROTISTS. Technical Progress Report. ([Illinois. Univ., Urbana]). Jan. 19, 1962. Contract AT(11-1)-878. 4p.

Progress of research on the nature of the recovery of division processes in irradiated protists is described. No division block was found in Brachiomonas submarina after doses of 2.5 kr, which reduce colony formation ~50%. Chilomonas irradiated with u-v after resuming division after x irradiation did not show a great secondary suppression. The effects of several chemical agents on the growth of Tetrahymena and Chilomonas were studied. (D.L.C.)

8542 (TID-14829) THE GENETIC BASIS AND PRACTICAL SIGNIFICANCE OF MUTATIONS INDUCED IN OATS AND BARLEY WITH IONIZING RADIATIONS. Progress Report, 1961–1962. David T. North (Minnesota. Univ., St. Paul). Contract AT(11-1)-332. 7p.

Progress is reported on studies of pre-irradiation heat treatment and sensitivity of seeds to storage and oxygen, back mutation in higher plants, and the economic significance of radioinduced mutations and structural changes in barley, oats, and wheat. (M.C.G.)

8543 (TID-14831) [EFFECTS OF RADIUM ON STREAM ALGAE AND FISH BLOOD]. Technical Progress Report. (Utah State Univ., Logan). [nd]. Contract [AT(11-1)-1023]. 3p.

Experiments are being carried out to determine uptake rates and concentration factors of soluble radium by filamentous algae. The effects of radium on the cells and proteins of fish blood were determined. Results are presented in tabular form. (M.C.G.)

8544 (TID-14848) THE EFFECT OF ATOMIC BOMB RADIATIONS UPON THE GROWTH OF CHILDREN PRESENT AT HIROSHIMA ON AUGUST 6, 1945 (thesis). John V. Nehemias (Michigan. Univ., Ann Arbor). 1960 199p.

Data collected at Hiroshima by the Atomic Bomb Casualty Commission on the effects of ionizing radiation on the growth and development of children are presented and analyzed, particularly the PE-18 sample. The use of non-exposed children as controls is criticized. The exposure groups defined on the basis of radiation exposure index differ very significantly with respect to size, but the actual physical differences are small. Significant correlation coefficients between the anthropometric variables and radiation parameters were consistently observed, whether or not the non-exposed children were included. The results indicated a negative relationship between size and degree of radiation exposure. The validity of the data is discussed in detail. (D.L.C.)

8545 (TID-14857) THE RELATIONSHIP BETWEEN X-RAY DOSE AND TWO-HIT ABERRATIONS AS SCORED AT METAPHASE AND ANAPHASE OF MITOSIS (thesis). James H. Clark (Kansas. Univ., Lawrence). Jan. 1959. 34p.

The relationship between the dose of x rays and the frequency of two-hit chromosome aberrations in the Allium cepa root tip was explored. The relationship between the x-ray dose and anaphase bridges was found to be linear. The relationship between the dose of x rays and metaphase rings and dicentrics was found to be nonlinear. After an analysis of the results and the probable relationship between dose (D) and two-hit aberrations (A) scored as metaphase rings and dicentrics was found to be $A = 0.05954\,D^{1.373}$. The production of Allium cepa anaphase bridges was found to be dose rate dependent at the dose rates used. When the dose rate was raised there was a significant increase in two-hit aberrations. (M.C.G.)

8546 (TID-14866) THE EFFECTS OF HIGH OXYGEN TENSIONS ON POTASSIUM RETENTIVITY AND SURVIVAL OF BAKER'S YEAST (thesis). Bruce Owen Stuart (Rochester, N. Y. Univ.). 1959. 105p.

A description is presented of the experimental procedure for examining the effects of high O_2 pressures on the K retentivity behavior and survival of baker's yeast. Experimental results are included along with discussion of the observed effects and their correlation with the effects of ionizing radiation. (J.R.D.)

8547 (JPRS-11816) SOME EFFECTS OF ACUTE RADIATION SICKNESS UPON TISSUE. Translated from Patol. Fiziol. i Eksptl'. Terap., 5: No. 5, 59-70(Sept.-Oct. 1961). 29p.

Separate abstracts have been prepared for the two articles included. (C.H.)

8548 (JPRS-11816(p.1-15)) THE HUMORAL MECHANISMS OF MINERAL METABOLISM CHANGES IN CALCIFIED TISSUES IN ACUTE RADIATION SICKNESS. N. A. Zhizhina and A. A. Prokhonchukov. Translated from Patol. Fiziol. i Eksptl'. Terap., 5: No. 5, 59-65(Sept.-Oct. 1961).

In experiments on parabiotized rats, using the method of radioactive indicators, the role of the humoral factor was elicited in the mechanism of mineral metabolism disturbances in calcified tissues (bones and teeth). The radiation effect, as related to the phosphorus-calcium metabolism in the bones and teeth in a non-irradiated parabiont, is directly dependent on the dose of x rays received by its partner as well as by the time factor. The radiation effect is most clearly manifested on the 5th to 12th day after an exposure to 1000 r. Examination of the content of stable calcium of the blood serum indicates that this factor is of no importance in the mechanism of metabolic mineral changes in the bones and teeth of a non-irradiated parabiont. Experiments on parabiotized rats demonstrated the possibility of reproducing the radiation effect in regard to the calcified tissues of a non-irradiated parabiont on the basis of humoral mechanisms. The humoral factor can be regarded as one of the important pathogenetic components in the development of the radiation syndrome. (auth)

8549 (JPRS-11816(p.16-28)) PHENOMENA OF SENSITIZATION OF LOOSE CONNECTIVE TISSUE IN ACUTE RADIATION SICKNESS. V. V. Shikhodyrov, R. V. Petrov, and M. F. Sbitneva. Translated from Patol. Fiziol. i Eksptl'. Terap., 5: No. 5, 66-70(Sept.-Oct. 1961).

Following irradiation of the organism, a reaction appears in the loose connective tissue (LCT) which is characteristic of conditions connected with antigenic sensitization. Morphologically, this reaction is manifested in the increase of the number of macrophages, rejuvenation of the cellular composition, foaming, and vacuolization of the protoplasm of fibroblasts. The reaction originates directly after irradiation and lasts 1 to 2 days. Subsequently, dystrophic changes develop which are accompanied by the impoverishment of the connective tissue as regards cambial cells, young fibroblasts, macrophages, and mast cells. Upon sensitization with a heterogenous serum, during the first few hours a picture develops which is analogous to the 1st phase of LCT reaction after irradiation. Repeated ad-

ministration of the heterogenous serum leads to the normalization of LCT. Upon sensitization with tissue taken from irradiated animals, there are changes observed characteristic of the 1st phase of reaction to irradiation; upon second injection of these tissues, the changes are analogous to the ones during the height of acute radiation sickness. Sensitization with normal tissues causes no changes characteristic of any period of radiation sickness. The greatest resemblance of processes, characteristic of LCT in radiation sickness and states connected with animal sensitization with homologous and heterologous tissues, is observed when tissues from irradiated animals of the same species are used for sensitization. This fact indicates the important role of irradiation-altered autoproteins in the development of autosensitization in radiation sickness. (auth)

8550 (JPRS-11901) DETERMINATION OF THE EFFECT OF RADIATION UPON HUMAN HEREDITY BY STUDYING CHROMOSOME DISEASE. V. P. Efroimson. Translated from Byull. Moskov. Obshchestva Ispytatelei Prirody, Otdel Biol., 65: No. 3, 150(May-June 1960). 9p.

As a means for determining the radiation dose that doubles the frequency of mutation in man, it is suggested that the frequency of occurrence of a group of diseases of the so-called chromosome etiology (viz. Down's syndrome, Klinefelter's syndrome, the Shereshevskii-Turner syndrome, and the XXX syndrome) be studied in relation to the radiation exposure. These diseases are chosen because they are independent of consanguinous marriages and fluctuations in reproduction, easily diagnosed, and because they do not often originate as a result of mutation. (T.F.H.)

8551 (JPRS-11903) CANCER THERAPY BY MEANS OF INTRATUMORAL DEPOSITION OF RADIOACTIVE COLLOIDS AND SUSPENSOIDS. RESULTS AND LIMITS OF THE TREATMENT. M. Klvana, M. Pivonka, M. Zaduban, J. Kubicek, and J. Lukan. Translated from Neoplasma, 8: 331-5(1961). 7p.

The intratumoral injection of colloids and suspensoids containing Au^{198}, P^{32}, Lu^{177}, Bi^{206}, or Y^{90}, as a therapeutic measure in the treatment of various types of cancers (of the parotid gland, skin mucous membranes, breast, bladder, epipharynx, tonsil, tongue, vulva, etc.), is studied. Positive results are obtained in 10 out of 22 cases; however, necrosis occurs in some cases. Total biological doses range as high as 200,000 β rad. (T.F.H.)

8552 (JPRS-12021) MEDICAL RADIOLOGY. Translation of Meditsinskaya Radiologiya, 6: No. 9, 1-98(Sept. 1961). 159p.

Translations are presented for 22 articles in the fields of radiotherapy, radiation effects, radiation sickness, radiobiology, and related subjects. These articles were previously abstracted from the original language and appeared in Nuclear Science Abstracts. (C.H.)

8553 (JPRS-12102) MEDICAL RADIOLOGY. Translation of Meditsinskaya Radiologiya, 6: No. 10, 3-96(Oct. 1961). 167p.

Translations are presented for 23 articles in the fields of radiotherapy, radiation effects, radiation sickness, radiobiology, and related subjects. These articles were previously abstracted from the original language for Nuclear Science Abstracts. (C.H.)

8554 STUDIES OF THE EFFECT OF X-RAYS ON THE GLUCURONIDE SYNTHESIS AND β-GLUCURONIDASE ACTIVITY IN THE DUODENAL MUCOUS MEMBRANE OF THE RAT. K. Hartiala, V. Naentoe and U. K. Rinne (Univ. of Turku, Finland). Acta Physiol. Scand., 53: 376-80(Nov.-Dec. 1961). (In English)

The glucuronide conjugation and β-glucuronidase activity of rat duodenal mucosa were studied after local x irradiation. The results show that a slight decrease was present in the conjugation capacity of glucuronide 12 hours after treatment with both 400 and 1200 r irradiation. This was followed by an increase within the next 12 hours. After this the conjugation capacity diminished greatly so that the decrease was 58% with the 400 r dose and 71% with the 1200 r dose. The conjugation capacity approached the control level within 8 days, and 20 and 30 days after the irradiation it was above the control level. After a slight initial decrease 12 hours after the treatment, the enzyme activity in β-glucuronidase rose, being at its maximum 3 days after the irradiation. The increase was 50% with the 400 r dose and 37% with the 1200 r dose. After this the activity settled to the control level. (P.C.H.)

8555 RENAL HYPERTROPHY AND FUNCTION IN IRRADIATED AND NEPHERECTOMIZED RATS FED A HIGH PROTEIN DIET. Frank Konishi and R. W. Brauer (U. S. Naval Radiological Defense Lab., San Francisco). Am. J. Physiol., 202: 88-90(Jan. 1962).

Male rats exposed to a total of 740 rad x irradiation were fed a high protein diet and unilaterally nephrectomized to investigate functional and compensatory regenerative capacity of the kidney as probable indices of residual radiation injury. The extent of compensatory hypertrophy after nephrectomy showed a significantly greater increase due to the high protein diet but no effect due to irradiation. Estimates of maximal tubular excretions of p-aminohippurate (PAH), however, were significantly greater in irradiated groups than in control groups when determined 3 weeks postnephrectomy. Renal clearances of C_{In} and C_{PAH} were significantly depressed after nephrectomy but not after radiation. Histological studies of the kidneys did not indicate renal damage by radiation except for an isolated instance of a renal neoplasm in an irradiated, nephrectomized rat fed a high protein diet. The results indicate that radiation does not modify compensatory hypertrophy after unilateral nephrectomy but appears to increase the apparent functional capacity of the tubules. (auth)

8556 RADIODERMATITIS FROM DIFFRACTION APPARATUS. W. W. McBride and Jan Lieben (Pennsylvania, Harrisburg. Dept. of Health). Arch. Environmental Health, 4: 191-5(Feb. 1962).

Four cases of radiodermatitis which resulted from misuse of x-ray diffraction equipment are presented. The problem in protection of the worker using x-ray diffractometers does not appear to be primary or secondary x-ray radiation from tube leakage or stray radiation, but rather failure to appreciate the hazards associated with the use of these devices. When used properly, the x-ray diffractometer is an extremely valuable tool for industry. It behooves the manufacturers of this equipment, as well as the users, to be aware of the hazards and to instruct personnel using these devices to handle them properly. A well-functioning protective shield must be provided and properly positioned before specimens are placed within the unit. Under no circumstances should the housing be removed to permit analysis of specimens of large size, nor should specimens be held within the beam. The unit must always be disconnected before adjustments or repairs are made. Had these necessary precautionary measures been taken, the cases of radiodermatitis presented here could have been prevented. (auth)

8557 SEX DIFFERENCES IN MAZE LEARNING ABILITY OF PRENATAL RADIATED RATS. S. J. Kaplan and V. P. Luchsinger (Texas Technological Coll., Lubbock). Atompraxis, 8: 1-3(Jan. 1962). (In English)

Eighty-four albino rats (age 90 to 100 days) were trained on one of two mazes. 26 were normal controls, 31 received 50 r on the 8.5 gestation day, and 27 received 150 r on the 8.5 gestation day. While no differences were found between the learning ability of the normal control males and females, statistically significant differences were found in favor of the males over the females of the combined radiated groups. The results suggest that; radiation has a greater adverse effect upon the learning ability of the female than upon that of the male; that lower doses than heretofore reported may have a deleterious effect upon maze learning; and that an endocrine malfunction, which interacts to interrupt effective cognition, may account for the greater learning deficit in the female. (auth)

8558 STIMULATION OF GROWTH IN SINAPIS ALBA BY MEANS OF X-IRRADIATION. Th. von Kreybig and R. Schagen (Universität, Tübingen, Ger.). Atompraxis, 8: 6-7(Jan. 1962). (In German)

A stimulation of growth during the entire period of vegetation was observed in Sinapis alba after low-dose x irradiation. Higher doses produced a marked inhibition of growth at first, but towards the end of development the growth intensity of these experimental plants was also greater than that of the control plants, with no delay in maturation. (auth)

8559 A CHEMICAL BASIS FOR THE SENSITIZATION OF BACTERIA TO ULTRAVIOLET LIGHT BY INCORPORATED BROMOURACIL. Kendric C. Smith (Stanford Univ., Palo Alto, Calif.). Biochem. Biophys. Research Communs., 6: 458-63(Jan. 24, 1962).

Studies show that at least one explanation for the enhancement of bacterial sensitivity to ultraviolet light by incorporated bromouracil (BU) is its greater photochemical lability in vivo relative to thymine. This is evidenced both by a greater rate of photochemical alteration (1.9 times greater than thymine) and also by a greater number of photochemical products formed. (auth)

8560 STABILITY OF A DEOXYRIBONUCLEIC ACID-SYNTHESIZING SYSTEM TO X-RADIATION. E. R. Walwick and R. K. Main (U. S. Naval Radiological Defense Lab., San Francisco). Biochim. et Biophys. Acta, 55: 225-7(Jan. 22, 1962). (In English)

The effect of x radiation on the incorporation of tritiated thymidine into desoxyribonucleic acid (DNA) was studied in an enzymatic system from rat thymus after primer desoxyribonucleic acid was exposed to various doses of x radiation. Data are presented graphically. It was concluded that the DNA primer, and the enzyme system for DNA synthesis, preformed by kinase, polymerases, and glycalytic enzymes, were unaffected by x radiation in the dosage range of 250 to 10,000 rads. (C.H.)

8561 INHIBITION OF DEOXYRIBONUCLEIC ACID BREAKDOWN IN X-IRRADIATED ESCHERICHIA COLI BY VARIOUS COMPOUNDS. E. Kos and M. Drakulić (Institute "Rudjer Bošković," Zagreb and Univ. of Zagreb). Biochim. et Biophys. Acta, 55: 248-9(Jan. 22, 1962). (In English)

Results are reported from a series of experiments on the effect of various compounds on the x-ray-induced breakdown of desoxyribonucleic acid in Escherichia coli. Citrate, succinate, glutamate, and adenosine triphosphate were found to inhibit the breakdown of DNA completely. Monophosphorylated derivatives of adenosine were also effective, but adenosine diphosphate was significantly less effective. In irradiated cells, incubated in acetate buffer alone, or in pyrophosphate or Mg^{2+}-containing buffer, the breakdown of desoxyribonucleic acid was very extensive. Possible reaction mechanisms are discussed. (C.H.)

8562 PROTEIN SYNTHESIS AND VIABILITY IN X-IRRADIATED RHODOPSEUDOMONAS SPHEROIDES. Roderick K. Clayton and Howard I. Adler (Oak Ridge National Lab., Tenn.). Biochim. et Biophys. Acta, 56: 257-67(Jan. 29, 1962). (In English)

In the photosynthetic bacterium Rhodopseudomonas spheroides the capacity for induced catalase synthesis was inhibited by low doses of x rays to the same extent as the ability to form colonies. The inhibition was manifested fully within a few minutes after irradiation. The presence of catalase during and after irradiation did not modify the effect of x rays on survival, and the activity of intracellular catalase was not altered by x ray doses up to 100 kr. The effects of x rays on catalase synthesis and survival were potentiated to the same extent by oxygen. Experiments dealing with kinetics and external factors suggested that x rays act in an all-or-none manner, early in a sequence of events that culminates in synthesis of the enzyme. The syntheses of general cell protein, of proteins associated with bacteriochlorophyll in the chromatophores, and of constitutive catalase were inhibited by x irradiation to about the same extent as the synthesis of inducible catalase and the ability to form colonies. The lethal action of x rays is discussed in terms of the destruction of genetic material that directs the synthesis of proteins. (auth)

8563 FAILURE OF ULTRAVIOLET-IRRADIATED ESCHERICHIA COLI TO PRODUCE A CROSS-REACTING PROTEIN. Millicent Masters and Arthur B. Pardee (Univ. of California, Berkeley). Biochem. et Biophys. Acta, 56: 609-11(Jan. 29, 1962). (In English)

Tests were performed on E. coli in order to determine if the irradiated organisms synthesize a cross-reacting protein instead of active enzyme. Cross-reacting material was not detected in any of the irradiated cultures. From this result, it was concluded that production of an immunologically similar but enzymically inactive protein does not account for a significant part of the disparity between total protein and detectible enzyme synthesized after irradiation. Apparently any ultraviolet lesion is sufficiently severe to prevent the formation of a slightly damaged but immunologically active protein. (P.C.H.)

8564 SPECTROPHOTOMETRIC AND RADIOISOTOPE INVESTIGATION OF PREPARATIONS OF DEOXYRIBONUCLEIC ACID ISOLATED FROM THE RAT LIVER AFTER EXPOSURE TO STRONTIUM 90. M. S. Uspenskaya. Biophysics (U.S.S.R.) (English Translation), 5: No. 6, 803-10 (1960).

Solutions of the DNA preparations of the liver obtained from rats exposed to Sr^{90} (in equilibrium with Y^{90}) absorb less ultra-violet light (260 mμ) and the greatest decrease in optical density of DNA solution was manifest 5 hr after injection of the radioactive isotopes. The preparations of high polymer DNA isolated from the rat liver 1 and 5 hr and 1 and 3 days after injection of Sr^{90} ($+Y^{90}$) possessed radioactivity; the maximum radioactivity of DNA was noted 5 hr after injection. The maximum radioactivity of the protein component of DNP of the liver was detected 3 days after exposure of the animals to Sr^{90}. The greatest accumulation of radioactive isotopes in the liver occurred 5 hr after their injection into the body. The radioactivity of the

DNA preparations, the DNP proteins and the intact liver tissue after exposure Sr^{90} ($+Y^{90}$) was due to the presence in them both of Sr^{90} and Y^{90}. The relation between these radioactive elements in the preparations tested varied with the period of observation. (auth)

8565 DISTURBANCE OF OXIDATIVE-REDUCTION PROCESSES IN PLANT TISSUES UNDER THE INFLUENCE OF IONIZING RADIATION. A. M. Kuzin and V. A. Kopylov (Inst. of Biological Physics, Academy of Sciences, Moscow). Biophysics (U.S.S.R.) (English Translation), 5: No. 6, 810-14(1960).

The metabolic processes in leaves after x irradiation with a dose of 10,000 r were investigated. It was shown that immediately after irradiation the pH of the homogenates of the irradiated leaves shifts to the acid side in relation to the controls. Raised susceptibility to oxidation by atmospheric oxygen of the homogenates of the irradiated leaves, as compared with the unirradiated ones, was demonstrated, and raised activity of tyrosinase in irradiated leaves was shown. An increased content of quinone-like substances in the irradiated leaves, as compared with the controls, was demonstrated. Increases, though diminishing in time, were distinctly manifest 24 hr after irradiation. The hypothesis is advanced that the products of quinoid nature formed on oxidation of tyrosine may be responsible for the depression of cell division usually observed on irradiation of plants. (auth)

8566 LOCAL REACTION OF TISSUE TO IRRADIATION. A. D. Strzhizhovskii. Biophysics (U.S.S.R.) (English Translation), 5: No. 6, 814-20(1960).

Irradiation of tissues in culture results in cells which are damaged to varying degrees and the cell population of the tissue becomes inhomogenous. A mathematical formula is presented for calculating the number of cells damaged by irradiation per unit in time for various radiation doses. The reactions of cells in tissue culture to various radiation doses are discussed. (C.H.)

8567 FUNCTION OF RECOVERY ON IRRADIATION OF ORGANISMS. K. K. Aglintsev (Khlopin Radium Inst., Academy of Sciences, Leningrad). Biophysics (U.S.S.R.) (English Translation), 5: No. 6, 839-45(1960).

An attempt is made to establish certain properties of the dependence of the effect of irradiation to the body on the dose rate. A formulation is presented for the mathematical prediction of recovery from radiation injuries. It is pointed out that equations cannot disclose the nature of the process of recovery but only indicate probable recovery at various doses of biological significance and various irradiation times. (C.H.)

8568 CHEMICAL STRUCTURE OF STREPTOMYCIN AND THE CHANGE IN FREQUENCY OF NUCLEAR DAMAGE OF IRRADIATED MAMMALIAN CELLS. N. I. Shapiro and N. V. Belitsina (Inst. of Biological Physics, Academy of Sciences, Moscow). Biophysics (U.S.S.R.) (English Translation), 5: No. 6, 853-6(1960).

The chemical structure of streptomycin is reviewed. Results are reported from studies on the effects of streptidine on the frequency of radiation-induced chromosome aberrations in mouse Ehrlich ascites tumor cells. From results of this study it is concluded that the anti-radiation effect of streptomycin is wholly determined by the presence of its molecule of streptidine. Further investigations concerning the nature of the effect of streptidine showed that this substance contains reactive guanidino groups which are responsible for its beneficial influence in radiation injuries. The efficacy of substances of similar structure in reversing nuclear damage caused by irradiation was investigated. It was found that arginine is just as effective in combating radiation effects as streptomycin and streptidine. Guanidine, norvaline, and ornithine also exerted a favorable effect. It was concluded that the reversibility of radioinduced nuclear damage is due to substances containing a guanidino group, but not to guanidine itself. To be effective, the guanidino group must be linked with 4-hydroxycyclohexane in streptine or with the amino acid residue of arginine. Guanidine alone or the amino acid without guanidine did not have a protective effect. A possible relationship between the reduction of chromosome aberrations and desoxyribonucleic acid content is suggested. (C.H.)

8569 EXPERIMENTAL STUDIES ON TISSUE RESPIRATION IN THE BONE MARROW AND LIVER OF GUINEA PIGS AND MICE INJECTED WITH RADIOACTIVE PHOSPHORUS P^{32}. Toshie Iwamura. Boei Eisei, 8: 42-53(Feb. 1961). (In Japanese)

The tissue respiration in the liver and bone marrow of guinea pigs and mice was measured in 1 to 4 weeks after an intraperitoneal injection of 3.0μc/g body wt of P^{32} to guinea pigs and that of 5.0μc/g to mice. Several kinds of organic acids related to the TCA cycle were added. The endogenous respiration in the bone marrow of guinea pigs was remarkably reduced while the oxidation rate of organic acid was either as usual or promoted. When ATP was added, oxygen consumption tended to be normal. The endogenous respiration in the liver of guinea pigs hardly varied from the normal one and the oxidation rate of organic acid did not show any fixed tendency. The endogenous respiration in the liver of mice was reduced and the oxidation rate of organic acid was either intact or promoted. In other words, the oxidation rates of pyruvate, α-ketoglutarate, and succinate were promoted and the increasing rate was greater than usual when both ATP and dithioctanoic acid plus succinate were added, so that all the oxygen consumption caused by addition of the above-mentioned materials tended to approach the normal level. (auth)

8570 CELL POPULATION KINETICS FOLLOWING DIFFERENT REGIMES OF IRRADIATION. L. G. Lajtha, D. Phil, and R. Oliver (Churchill Hospital, Oxford). Brit. J. Radiol., 35: 131-40(Feb. 1962).

Population kinetic patterns for different model cell populations (normal and malignant) are presented, and their behavior under various regimes of irradiation is considered. The significance of intermitotic cycle time and of cell population doubling time in determining optimum dose fractionation in radiotherapy is discussed. (auth)

8571 INITIAL ACTIONS OF IONIZING RADIATIONS. J. W. Hunt (Ontario Cancer Clinic). Can. Nuclear Tech., 35-9(Winter 1959).

The initial process of radiation damage is described beginning with the formation of ionized molecules along the tracks of the radiation particles. These ions immediately dissociate to form free radicals, and the free radicals react to produce permanent damage to some key molecules. The tracks of ionized molecules may pass through some sensitive region or target in which a single ionization may inactivate the molecule, the particle, or the cell. The larger the target, the easier it is to hit. The dose required for inactivation decreases with increasing target size. The role which free radicals play in radiation damage is investigated by electron spin resonance. Experiments indicate that changes induced in these free radicals will alter the course and extent of the radiation damage. It is pointed out that the problem of the high sensitivity of

cells to radiation damage may be solved by a further understanding of the initial action of radiation. (N.W.R.)

8572 NATURAL HYBRIDIZATION WITH AND WITHOUT IONIZING RADIATION IN SOYBEANS. C. R. Weber and W. D. Hanson (U. S. Regional Soybean Lab., and Iowa Agricultural and Home Economics Experiment Station, Ames). Crop Sci., 1: 389-92(Nov.-Dec. 1961).

Natural hybridization in soybean varieties with and without ionizing radiation was measured under field conditions in two widely separated geographical locations, Iowa and Maryland. The different soybean varieties used as pollen-donor parents possessed dominant marker genes so that hybrids could be detected in the recessive female recipients. Natural crossing percentages occurring in the controls approximated 1.0% when the genotypes were grown in close contact. On the average, heavy dosages of approximately 2.0×10^{13} thermal neutrons or 20,000 r x rays when applied to seed of only female recipients increased natural crossing 4 to 6 times as compared with controls. Within the dosage ranges of irradiation studied, x rays appeared to be just as effective as thermal neutron in causing hybridization. Incidence of natural crossing increased as dosage levels of x rays and thermal neutrons increased, whereas maturity was delayed and seed yield decreased progressively. In the Iowa test, flowers on the upper half of female recipient plants were cross-fertilized more than flowers on the lower half of these same plants with or without irradiation. Insect vector or vectors were believed to be the main reason for hybridization in these tests in both states. The results suggested that natural crossing in soybeans could be increased more than obtained herein with or without irradiation by better timing of flowering of pollen donors and recipients. The use of irradiation to induce hybridization and its role as a tool for greater genetic recombination in self-pollinated hybrid populations are discussed. The results suggested that if a true index of ionizing radiation-induced mutations is to be obtained, greater than normal precautions must be taken to isolate irradiated material from outside pollen sources. (auth)

8573 SOME EFFECTS OF GAMMA AND NEUTRON IRRADIATION OF SEEDS ON GERMINATION AND SEEDLING GROWTH OF RED CLOVER. Norman L. Taylor, Elmer Gray, W. H. Stroube, and W. A. Kendall (Kentucky Agricultural Experiment Station and the Crops Research Div., Lexington). Crop. Sci., 1: 458-60(Nov.-Dec. 1961).

The LD_{50} for red clover seed was found to be about 3 hr of neutron and 100 kr of γ irradiation. These figures are interpolated from data obtained from field and greenhouse plants grown from seeds irradiated at 18 mo of age. Data are included on germination, growth, pollen viability, and effects of aging in seeds exposed to various doses of γ and neutron irradiation. (C.H.)

8574 RESTORATIVE PROCESSES IN OSSEOUS TISSUE AFTER LOCAL X-RAY IRRADIATION. S. A. Ivanova (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 141: 966-9(Dec. 1, 1961). (In Russian)

Seven groups of white rats were given a local x-ray dose of 2000 r on the left rear extremity, and subjected to a resection of the tibia diaphysis. Group I was irradiated and operated on 3 days later. Group II was operated on and irradiated three days later. Group III was irradiated and operated on 8 days later. Group IV was operated on and irradiated 8 days later. Group V was irradiated and operated on 14 days later. Group VI was operated on and irradiated 14 days later. Group VII, the control group, was operated on but not irradiated. Active growth of the tibia was observed in the control group (Group VII). Regenerative processes could not be detected in Group I in the majority of the cases. Tibia growth took place in groups II and IV, but was not observed in groups III and V in the majority of the cases. Tibia growth occurred in group VI. The growth or slow-down in regenerative processes were followed by histological analysis. (TTT)

8575 RADIATION ANALYSIS OF THE DURATION OF MEIOTIC PHASES IN THE SPERMATOGENESIS OF THE MONKEY (MACACA MULATTA). M. A. Arsen'eva, N. P. Dubinin, N. N. Orlova, and E. D. Bakulina. Doklady Akad. Nauk S.S.S.R., 141: 1486-9(Dec. 21, 1961). (In Russian)

A study was made of the relative period of various developmental stages of spermatogonia of the monkey. Data are tabulated on the analysis of 1542 seminal canals from which the relative duration of each meiotic stage can be calculated. The change in achromatid arrangement as revealed by histological staining techniques was used as a measure of determining the stages of spermatogenesis. After irradiating 10 monkeys with a 100 r dose of x-rays, analyses were carried out on embryonic epithelium cells 10, 15, 20, 25, 30, 48 hours, and 17 days 15 hours after irradiation. Castration was also performed on a group of 15 monkeys each 24 hours from the first day to the 20th day after irradiation. Type B (B_1, B_2, and B_3) spermagonia could not be observed 10 hours after irradiation. These cells were the most radiosensitive for a 100 r irradiation. The duration of the meiosis as a whole was found to be 17 days or 408 hours, as shown by the disappearance of the occurrence of the later stages of meiosis in stained testicular sections. It was determined that multiplication of spermatogonia (from A_1 to spermatocytes of the first order) lasts for 905 hours, meiosis lasts 408 hours and the stage of spermatid development lasts 366 hours. The duration of the whole period of spermatogenesis is 1682 hours or about 70 days. (TTT)

8576 EFFECTS OF β-RADIATION ON MERISTEMS. F. A. L. Clowes (Oxford Univ.). Exptl. Cell Research, 25: 529-34(Dec. 1961).

When a root meristem suffers heavy radiation damage by the incorporation of large amounts of tritiated thymidine into its nuclei it can form a new meristem from cells of its quiescent center. The presence of the quiescent center explains the survival of roots after severe irradiation. (auth)

8577 THE MUTUAL RELATIONSHIPS OF SPLEEN AND BONE MARROW IN RADIATION REACTIONS. IV. THE EFFECT OF SPLEEN IRRADIATION ON THE PERIPHERAL BLOOD PICTURE OF HEALTHY LABORATORY RATS. R. Bauer and H. Hartweg (Universität, Tubingen, Ger.). Fortschr. Gebiete Röntgenstrahlen u. Nuklearmed., 95: 682-7(Nov. 1961). (In German)

Following simple operative exposure of the spleen, as well as after subsequent irradiation, there is a nonspecific reaction in the peripheral blood during the first ten days characterized by lymphopenia and simultaneous granulocytosis. These changes are also initiated by percutaneous irradiation of the spleen. These, however, are followed by a marked alteration in the granulocytic series, indicating the activity of a leucodepressing factor. This factor depends on dose. In addition the validity of Wilder's law could be demonstrated for this mechanism. (auth)

8578 THE EFFECT OF X IRRADIATION ON THE EOSINOPHIL CELL COUNT IN HEALTHY AND TUMOROUS RATS. E. Soevenyi, L. Lakatos, and A. Benkoe (Univ. of Szeged). Fortschr. Gebiete Röntgenstrahlen u. Nuklearmed., 95: 688-94(Nov. 1961). (In German)

Irradiation results in eosinophilia during the first four hours after the exposure, followed by a more prolonged

eosinopenia, both in normal and tumor bearing rats. In the latter, eosinopenia is significantly more marked than in normal animals. Dicaptol prevents the eosinophilia observed during the first four hours after irradiation in both normal and tumor bearing animals. (auth)

8579 BACTERICIDAL EFFECT ON HIROSHIMA OYSTERS OF Co^{60} γ-RAYS. Satoru Tsuda and Satoshi Sasaki. Hiroshima Daigaku Kogakubu Kenkyû Hôkoku, 9: 39-46(1961).

The bactericidal effect of γ-ray irradiation with Co^{60} for oyster preservation was studied. A 7×10^4 r dose, given in 0.85% NaCl solution, to the 8 species of bacteria isolated from oysters, resulted in almost complete sterilization. About 5 times as much radiation was necessary for complete sterilization of oyster homogenates. A viability test and chemical analyses showed that 3.5×10^5 r was a satisfactory means of oyster preservation. (Chem. Absts.).

8580 FILAMENT FORMATION IN RADIORESISTANT MUTANTS OF ESCHERICHIA COLI S AFTER TREATMENT WITH ULTRAVIOLET LIGHT AND RADIOMIMETIC AGENTS. Janet Curry and Joseph Greenberg (Stanford Research Inst., Menlo Park, Calif.). J. Bacteriol., 83: 38-42(Jan. 1962).

The effect of ultraviolet light and of five radiomimetic compounds on cell division, growth in liquid medium, and growth in solid medium of Escherichia coli S and four of its radioresistant mutants was examined. All of the agents, including ultraviolet light, induced filaments in the parent S and in at least one of its radioresistant mutants. Two of the agents, azaserine and mitomycin C, induced filaments in three of the mutants, and in only one mutant were no filaments induced by any agent. Growth in solid medium was more sensitive to the agents than was growth in liquid medium. The mutants differed among each other in their degree of resistance to most of the chemical agents, when inhibition of growth in agar was used as the criterion. There was no difference among the mutants in the dose of any agent required to inhibit overnight growth in liquid medium. (auth)

8581 EFFECT OF X-RAY IRRADIATION ON THE FUNCTION OF HAEMOGLOBIN. A. Kajita, A. Hashimoto, T. Okazaki, and K. Kaziro (Nippon Medical Coll., Tokyo). J. Biochem. (Tokyo), 49: 538-47(1961). (In English)

Horse hemoglobin was irradiated with x rays and the ethylisocyanide (EIC) binding reaction of the hemoglobin was investigated. Results: From the EIC equilibrium, it was ascertained that the heme-heme interaction and the Bohr effect of hemoglobin decreased markedly, whereas EIC affinity increased intensively on irradiation. The radiation effect increased in proportion to the radiation doses, the modification of hemoglobin being at its maximum state on the radiation doses exceeding 6000 r. In this state, the function of hemoglobin was quite similar to that of myoglobin which has no heme-heme interaction, no Bohr effect, and a high EIC affinity. These changes in the EIC binding function of hemoglobin seem to be due to modification of the globin moiety. The observed leftward shift and the asymmetric figure of the EIC equilibrium curve were explained by the mixed system of two components, native and modified hemoglobin. A theoretical equation for EIC equilibrium curve of a mixed system is proposed. The results obtained were in good agreement with the theoretical curve. Myoglobin, when irradiated in its ferric state, showed no change on the EIC equilibrium curve as compared with that of native myoglobin, whereas irradiated methemoglobin gave a similar change as in the case of oxyhemoglobin. Catalase protected hemoglobin from irradiation by 20%. Addition of glutathione before irradiation protected hemoglobin completely, although after irradiation restoration occurred only by 41%. PCMB protected hemoglobin by 61%. Irradiation did not accelerate the decomposition rate of hemoglobin to verdohemoglobin. The possible role of sulphydryl groups on the modification of hemoglobin by irradiation is discussed on the basis of these results. (Abstr. Japan Med., 1: No. 15, 1961)

8582 EFFECTS OF IONISING RADIATION ON THE ACID METABOLISM OF APPLES (COX ORANGE PIPPIN). S. J. G. Fernandes and I. D. Clarke (Wantage Research Lab., Berks, Eng.). J. Sci. Food Agr., 13: 23-8(Jan. 1962).

An accelerated loss of titratable acidity occurs in irradiated fruit during storage at 37°F. The principal acids contributing to the titratable acid values were identified and determined quantitatively. Changes in the titratable acid values were shown to be due primarily to changes in the malic acid content. (auth)

8583 THE EARLY AND RAPID DIAGNOSIS OF SO-CALLED IRRADIATION DAMAGE BY ESTIMATION OF THE CELLULAR BLOOD ELEMENTS ESPECIALLY OF THE THROMBOCYTES, BY MEANS OF AN AUTOMATIC COUNTING APPARATUS. E. H. Graul and K. Damminger (Philipps-Universität, Marburg/Lahn, Ger.). Med. Klin. (Munich), 54: 1367-75(July 1959). (In German)

A method of determining the individual radiation injuries in a nuclear catastrophe in which 100,000 or more persons must be examined is described. The early reactions of the corpuscular blood elements to radiation, especially the thrombocytes, was used as the basis of the diagnostic technique. The apparatus and the method for automatic counting of the thrombocytes are described. By means of analysis of the form of the curve pattern, a satisfactory prognosis of the acute radiation syndrome is possible. (M.C.G.)

8584 EXPERIMENTAL STUDY OF THE ACTION OF RADIOACTIVE PHOSPHORUS (P^{32}) ON FERTILITY. E. A. D. Holmberg, A. Pavlovsky, E. Pedace, Elsa Arini, Christine Dosne de Pasqualini, and S. L. Rabasa (Instituto de Investigaciones Hematologicas, Academia Nacional de Medicina, Buenos Aires). Medicina, 21: 84-6(May-June 1961). (In Spanish)

The effect of P^{32} on the gonads was studied in Balb mice. The ovaries were more sensitive to the agent since 40 μc produced complete sterilization for at least 5 months after its administration while the testes were resistant to doses up to 205 μc which were lethal to 5 out of 8 animals. The histological pattern of the ovaries was one of complete disappearance of immature follicles and generalized luteinization. The testes did not show any particular qualitative or quantitative alteration. Pregnancy protected the animals since the sterilization dose was 90 μc which represents more than double the sterilization dose for a non-pregnant female. (auth)

8585 ACTION OF LOW DOSES OF IONIZING RADIATIONS ON THE ELECTROPHORETIC MOBILITY OF EHRLICH ASCITES TUMOUR CELLS. G. Stein, G. V. F. Seaman, and D. H. Heard (Cambridge Univ., Eng.). Nature, 193: 238-9(Jan. 20, 1962).

When standard washed Ehrlich ascites tumor cells were irradiated with small doses of gamma or x rays, it was found that as the dose increased, the electrophoretic mobility also increased up to a maximum value. Standard washed cells which were irradiated prior to washing in the presence of ascitic fluid immediately after its withdrawal from the mouse gave the same results, as also did washed cells which were obtained from a mouse immediately after it was

subjected to various doses of whole-body irradiation. When irradiation, at a dose-rate of 60 rads/min., was carried beyond 450 to 600 rads, the electrophoretic mobility was observed to decrease to a minimum at 900 rads, slightly lower than the value for the unirradiated controls. On further increase of the dose, the mobility increased to a new maximum at 1200 rads, equal to that obtained at 600 rads. Thereafter the mobility decreased again, reaching another minimum at about 1500 rads. The increase due to radiation was the same as that previously obtained with formaldehyde. (M.C.G.)

8586 LONG-TERM EFFECT OF TOTAL-BODY X-IRRADIATION ON THE COMPENSATORY HYPERTROPHY OF THE RAT KIDNEY. T. J. Franklin (Oxford Univ.). Nature, 193: 289-90(Jan. 20, 1962).

Tests were carried out on white rats to determine whether a sub-lethal total-body x-irradiation had any long-term effect on the rapid renal growth induced by a unilateral nephrectomy. The weights of the kidneys from the irradiated male animals were significantly smaller than those from the control animals and the concentration of DNA was higher than the control figure. In female rats, the values for the kidneys from the irradiated and unexposed animals were not significantly different. (M.C.G.)

8587 REPAIR OF RADIATION DAMAGE IN A NUCLEOPROTEIN BY CYSTEAMINE. M. G. Ormerod (Royal Military Coll. of Science, Shrivenham, Wilts, Eng.) and P. Alexander. Nature, 193: 290-1(Jan. 20, 1962).

Evidence obtained by using electron spin resonance which indicates that the prevention of radioinduced cross-linking of herring sperm heads by cysteamine occurs by a hydrogen transfer reaction is presented. Cysteamine prevents the cross-linking by sparsely ionizing radiations of deoxyribonucleic acid in the nucleoprotein. The electron spin resonance results indicate that the following reactions probably take place: $RH \rightsquigarrow R^{\bullet}$, $R^{\bullet} + RH \rightarrow RH + R^{\bullet}$, $R^{\bullet} + R^{\bullet} \rightarrow R-R$, and $R^{\bullet} + -SH \rightarrow RH + -S$. (M.C.G.)

8588 EFFECTS OF X-RAYS ON THE RAT EMBRYO DURING MESODERM FORMATION. N. Škreb and N. Bijelić (Faculty of Medicine, Zagreb). Nature, 193: 292-3 (Jan. 20, 1962).

During the early stages (8.5 and 9th days) of the mesoderm formation in rats, there was a great increase of resorption following irradiation. Contrary to other data available, there was no definite onset of incidence of malformations. (M.C.G.)

8589 ELECTRON SPIN RESONANCE MEASUREMENTS OF KERATINS TREATED WITH X-RAYS. B. Rajewsky and A. Redhardt (Max-Planck-Institut für Biophysik, Frankfurt am Main). Nature, 193: 365-6(Jan. 27, 1962).

The electron spin resonance spectra of some keratins were examined after x irradiation at 310 kr/min to the dose range 50 kr to 5 Mr. The results on feather quills as recorded at different times after x irradiation with 2.0 Mrad are given. The quills were irradiated under three experimental conditions: in normal air; over phosphorus pentoxide in air, after drying for 4 days at 43°C; and over phosphorus pentoxide in vacuum, after drying for 4 days at 43°C. The results show that in all cases there appears a transient line at the position of free electron spin that fades in the course of several hours. The presence of phosphorus pentoxide has a strong influence on the shape of the spectra. If the keratin is dried sufficiently, a slow rise with time is found in the low frequency part of the spectrum. It was concluded that the yield on cystine-like radicals in keratin is not essentially increased by energy transfer processes, which are related to a special protein structure. (P.C.H.)

8590 MODIFICATION OF THE RADIOSENSITIVITY OF HAMSTER CELLS IN VITRO. Malcolm A. Bagshaw (Stanford Univ., Palo Alto, Calif.). Nature, 193: 389-91(Jan. 27, 1962).

The radiosensitivity of hamster cells in vitro was increased by incubation with 5-bromodeosycytidine prior to x irradiation. The change in radiosensitivity was determined by a method in which the survival of clones as a function of x-ray dose was compared with the survival of clones derived from cells incubated for varying periods prior to irradiation in a medium containing 5-bromodeoxycytidine. Although the results do not permit quantitation, it was demonstrated that most of the bromine-82 was recovered from DNA fraction of cells incubated with Br^{82}-5-bromodeoxycytidine. It was concluded that 5-bromodeoxycytidine is an effective radiosensitizing agent for mammalian cells in vitro. (P.C.H.)

8591 INFLUENCE OF X-RAYS ON SEXUAL CYCLE AND PREGNANCY OF MICE. T. Suzuki (Keio Univ. School of Medicine, Tokyo). Nippon Funin Gakkai Zasshi, 6: No. 1, 1-18(1961).

After whole-body irradiation of 100 to 1000 r, sexual cycles of mature mice of the SM strain were observed for 50 to 70 days. Larger doses caused more marked changes of sexual cycles and shortened the period between irradiation and the disappearance of estrus. After irradiation with 1000 r all animals died within 13 days. Doses of 100 to 500 r were administered to the mice at various stages of pregnancy. These prevented weight gain during pregnancy and caused genital bleeding and/or absorption of the fetus. The degree of these radiation injuries paralleled the dose administered, and they were more dominant when irradiation was applied early in pregnancy. No definite fetal malformation was observed except in 2 cases, in which the lesions in the fetus were more marked than those in the placenta. (Abstr. Japan Med., 1: No. 15, 1961)

8592 CHANGES IN THE MINUTE BLOOD VESSELS OF THE INTERNAL ORGANS BY WHOLE-BODY X-RAY FRACTIONAL IRRADIATION. I. Hayakawa (Yokohama Univ. School of Medicine, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 817-42(1960).

The whole body, excluding the head, of mature rabbits was subjected to x radiation. Changes occurred with increasing severity, as the dosage was raised from 1000 to 5000 r. The maximum changes were seen one month after i. radiation. The dilatation and tortuosity of the capillary networks occurred immediately after irradiation, followed one week later by more marked arterial dilatation and one month later by venous dilatation. The changes were functional and reversible except in the case of the kidney. The grade of sensitivity seemed to be in the following order: kidney, testicle, stomach, small bowel, colon, liver, lung, adrenal, spleen, myocardium. Glomerulosclerosis was seen 6 months after x irradiation of 5000 r. (Abstr. Japan Med., 1: No. 15, 1961)

8593 THE SPECIFIC LOCALIZATION OF AUTO-ANTIBODIES PRODUCED BY X-RAY IRRADIATION IN THE HEART AS DETERMINED WITH RADIOACTIVE TRACERS. N. Hiramatsu (Iwate Medical Coll., Morioka, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2149-64(1960).

The distribution of radioiodinized globulin of anti-heart serum in the organs was determined by measuring the radioactivity. Rabbits injected with labeled globulin fraction presented specific localization of the radioactivity in the

heart as compared with rabbits injected with labeled globulin fraction of the control serum. When the labeled globulin fraction of iso- and hetero-antimyoglobin serum was injected, the localization of the radioactivity showed the same results as in the case of the injection of auto-antiheart serum. When rabbits were injected by the labeled auto-, iso-, and hetero-antiheart antibodies after an exposure of 5000 r of x ray to the heart, the accumulation of these in the heart of the rabbits decreased gradually in 1–2 weeks after the exposure. The decrease of in vivo localization of the anti-heart antibodies was probably due to the fact that the auto-antiheart antibodies produced by x irradiation to the heart had readily been saturated in the antibody-binding sites of the heart tissue antigen. It was concluded that a certain indirect action, induced by x irradiation on the heart, was caused by the process of auto-immunization, and that it was probably due to the localizing auto-antibody which played the role of the damaging agent. (Abstr. Japan Med., 1: No. 15, 1961)

8594 STUDIES ON THE COMBINED EFFECTS OF RADIATION AND VARIOUS CHEMICALS ON THE MITOTIC CELLS. XXI. EFFECTS OF COMBINED USE OF ARSENOBENZOL-NATRIUM WITH X-RAYS. M. Iijima (Hokkaido Univ. School of Medicine, Sapporo). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 984-94(1961).

Arsenobenzol-natrium of 9 mg/100 g injected into rats caused an increase of 10–15% in the number of mitotic cells of MTK sarcoma III while an injection of 18 mg/100 g caused a decrease of 48% 1 hr after the injection. The frequency of mitosis was not restored even 24 hr after injection. Mitosis in the prophase was decreased at once regardless of the dose administered. A clumping figure of chromosomes was seen after an injection of 18 mg/100 g, this was not observed after 3 mg/100 g or after 9 mg/100 g. X irradiation immediately to 1 hr after injection of arsenobenzol-natrium resulted in a slightly stronger inhibition of mitosis than x irradiation alone. X irradiation 3 and 6 hr after injection of arsenobenzol-natrium resulted in a slighter inhibition of mitosis than in the case of x irradiation alone. Injection of arsenobenzol-natrium after x irradiation caused inhibitory effects of both methods independently. (Abstr. Japan Med., 1: No. 15, 1961).

8595 SOME PHYSIOLOGICAL FACTORS INFLUENCING RADIATION SENSITIVITY. II. GLUCOSE CONCENTRATION. M. Kiga, T. Kamijo, H. Sakakibara, and H. Kubota (Showa Medical School, Tokyo). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2389-92(1961).

It was shown that oxygen consumption and carbon dioxide evolution were positively related to the concentration of glucose in certain culture media. On the contrary, reduction of these volumes by irradiation was inversely correlated. There were no noteworthy changes in the respiratory quotient as a consequence of irradiation. When colony counting was adopted as an indicator of radiation injury, the latter was inversely related to the volume of oxygen consumption and carbon dioxide evolution at the time of irradiation. (Abstr. Japan Med., 1: No. 15, 1961)

8596 STUDIES ON FIELD SIZE FACTOR. II. INFLUENCE OF DIFFUSIBLE SUBSTANCE ON THE INJURY OF THE IRRADIATED RABBIT'S SKIN. K. Nakanishi (Kyoto Prefectural Univ. of Medicine). Nippon Igaki Hoshasen Gakkai Zasshi, 20: 2415-24(1961).

When hyaluronidase was injected intracutaneously into a rabbit immediately before x irradiation with a small radiation field, skin reactions like epilation, erythema, or ulcer formation occurred to a much milder degree than with rabbits untreated with hyaluronidase. This may indicate that indirect rather than direct action of x ray plays a predominant role in producing the skin reaction. (Abstr. Japan Med., 1: No. 15, 1961)

8597 STUDIES ON THE INFLUENCE OF THE IRRADIATION OF VARYING DOSES OF X-RAY ON WEANLING MICE–MAINLY ON HAEMATOLOGICAL CHANGES. K. Sakaki (National Inst. of Animal Health, Tokyo). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2425-40(1961).

Mice of dd strain were exposed to a single whole-body x irradiation of 60, 120, 180, 300, and 600 r. The growth rate became slower as the dose rate was increased. Decrease in the erythrocyte count was manifested by irradiation of 300 r, more severely by irradiation of 600 r. Polychromatophilic erythrocytes were highly susceptible and showed a decreased count when exposed to 120 r. This decrease was more marked at 300 r, and with this dose of irradiation polychromatophilic erythrocytes occasionally disappeared entirely. With a dosage of 600 r they disappeared without exception within 2–7 days after irradiation. The leucocyte count was decreased by an irradiation of even 60 r. The differential leucocyte counts showed a slight decrease in lymphocytes with a relative increase in neutrophils. This tendency was more marked after irradiations of over 300 r. Relatively slight changes were observed in the number of eosinophils and monocytes. (Abstr. Japan Med., 1: No. 15, 1961)

8598 MACROSCOPICAL AND MICROSCOPICAL STUDY OF THE SKIN OF YOUNG RABBITS FOLLOWING LOCAL X-RAY IRRADIATION. M. Terauchi (Kyoto Prefectural Univ. of Medicine). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2441-59(1961).

The thighs of newborn rabbits were exposed to various doses of hard x rays (100, 200, 500, 1000, 5000, and 10000 r). Alopecia was caused by a single dose of more than 1000 r 6 days after exposure, and ulceration was caused by a single dose of more than 5000 r 21 days after exposure. In newborn rabbits both onset of and recovery from alopecia were much earlier than in the case of adult animals. There was no significant change in the cells of the epidermis but there was a marked decline in mitotic cell division in the hair bulbs from the 6th day after exposure. The order of sensitivity to irradiation of the skin tissues was: hair bulbs, epidermis, sebaceous glands, subcutaneous connective tissues, capillaries, and blood vessels. (Abstr. Japan Med., 1: No. 15, 1961)

8599 THEORETICAL APPROACH TO SHORTENING OF THE LIFE SPAN INDUCED BY RADIATION. PRELIMINARY REPORT. [PART I]. T. Sugahara. F. Sato, H. Eto, Y. Takeda, and T. Kankura (National Inst. of Radiological Science, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2463-9(1961).

Curves for mortality rate vs age were analyzed in terms of information theory. Differences of radiosensitivity in different animals were interpreted as the differences of information content which are decreased by any kind of disturbances, such as natural aging, irradiation, and intoxication. Assumptions made in expounding the present theory are as follows: there is a certain minimum value of information content for every animal in order to survive; the form of distribution of information content in animals is of normal type at first; and for natural aging, the decrease of information content corresponds in linear form with the factor of age. The results of caluclations were referred to previous experiments on mice by others. For the control group the only adjustable parameter was a median survival time which was taken as 650 days. The mortality

calculated showed close agreement with the experimental findings. Several survival curves proposed by others were also analyzed in the same way. Some corresponded well while others showed wide divergence from the information theory. It was concluded that differences in survival curves require further study. (Abstr. Japan Med., 1: No. 15, 1961)

8600 THE EFFECT OF X-RAY IRRADIATION ON RAT BONE MARROW BY AUTORADIOGRAPHIC STUDIES USING TRITIUM-LABELLED THYMIDINE. III. COMPARISON BETWEEN VARIOUS KINDS OF BONE MARROW CELLS AND PERIPHERAL BLOOD CELLS. SOME CONSIDERATIONS ON ABSCOPAL EFFECT OF X-IRRADIATION. R. Watanabe (Yokohama Univ. School of Medicine, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2470-85(1961)

Rats were exposed to 600 r whole-body irradiation. It was found that the large and small lymphocytes were very radiosensitive irrespective of their DNA-synthesizing ability. In this respect they were similar to K-1 cells of the erythropoietic series, though the reticulum and plasma cells remained radioresistant. The maximum inhibitory effect on DNA-synthesizing ability, indicated by a reduction of grain counts, was seen 6 hr after irradiation. It was followed by gradual recovery to normal 12 hr later in every kind of bone marrow cell. The grade of inhibition was greater in cells having active DNA-synthesizing ability. The difference in radiosensitivity between labeled and unlabeled cells was compared and considered. The percentage of thymidine uptake, the distribution of grain counts over cells, and their mean grain counts were tabulated for every kind of bone marrow cell and for peripheral DNA-synthesizing blood cells. Negligible DNA-synthesizing ability was found in small lymphocytes and plasma cells. (Abstr. Japan Med., 1: No. 16, 1961)

8601 STUDIES ON BLOOD AND BONE IN MICE IRRADIATED BY UV RAYS, USING DOUBLE-LABELLED P^{32} AND Ca^{45}. T. Murai (Osaka Univ. Medical School). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2522-31(1961).

An $H_3P^{32}PO_4$ solution and a $Ca^{45}Cl_2$ solution in the same cpm were mixed together to a total count of 500 cpm and administered to 100 mice. The similar Ca/P ratio in cpm was favorable to the study because of the good balance of P and Ca in the blood and bone. After the surface irradiation by UV rays of various wave lengths with a single dose of 5 w/cm^2 the amounts of P and Ca in bone and blood were increased 6 hr after exposure. The Ca/P ratio showed a greater decrease in cases of 25 w irradiation than in cases of 5 w. As to the P and Ca metabolism in the blood and bone, the influence of a wave length of 315 mμ was more effective than that of 360 mμ. (Abstr. Japan Med., 1: No. 15, 1961)

8602 AN ELECTRON-MICROSCOPIC STUDY ON THE EFFECT OF X-RAY IRRADIATION UPON LIVER MITOCHONDRIA. S. Mochizuki (Osaku Univ. Medical School). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2532-47(1961).

Changes of mitochondria in the liver of mice caused by whole-body x irradiation of 700 r were studied by the electron-microscope. Dilution and swelling of mitochondria was seen 30 min after irradiation, and disappearance of matrix and crista mitochondrialis 1 hr afterwards. Four hours after irradiation there was homogeneity of the matrix. A mixed picture of destruction and regeneration of mitochondria was observed 24 hr after irradiation. Changes of mitochondria caused by partial irradiation of the liver region were generally milder than in whole-body irradiation with the same dose. This may indicate that indirect rather than direct action plays an important role in changes of mitochondria of the liver. (Abstr. Japan Med., 1: No. 15, 1961)

8603 STUDIES ON THE COMBINED EFFECTS OF RADIATION AND VARIOUS CHEMICALS ON CELL DIVISION. XXII. THE COMBINED EFFECTS OF X-RAYS AND PREDNISOLONE ON MTK-SARCOMA III CELLS. T. Matsuda (Hokkaido Univ. School of Medicine, Sapparo). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2667-77(1961).

Three to four days after transplantation of MTK-sarcoma III in rats, prednisolone was given by intraperitoneal injection at a dose level of 10 mg per 100 g of body weight. The administration of prednisolone caused an increase in the frequency of mitosis after a preliminary slight decrease. The mitotic cells in each phase changed in proportion to the mitotic index. Morphologically, gradually after the injection, there appeared swelling or breakdown of the cytoplasm and abnormal chromosomes showing signs of stickiness and thickening in the metaphase. The injection of prednisolone after x irradiation resulted in slightly restrained mitosis. The combined effects of the prednisolone treatment followed by x irradiation, especially when the injection was given 3 to 5 hr before x irradiation, were seen in the marked morphological effects on the mitotic tumor cells. Even treatment with 0.1–0.5 mg prednisolone per 100 g of body weight 3 hr before x irradiation restrained the frequency of mitosis. Radiosensitizing effects on the sarcoma cells were observed as a result of prednisolone-treatment. (Abstr. Japan Med., 1: No. 15, 1961)

8604 STUDIES ON THE COMBINED EFFECTS OF RADIATION AND VARIOUS CHEMICALS ON THE MITOTIC CELLS. XXV. EFFECT OF COMBINED USE OF X-RAYS AND MALEIC ACID. K. Miyoshi (Hokkaido Univ. School of Medicine, Sapparo). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2678-86(1961).

The MTK-sarcoma was inoculated into the intraperitoneal cavities of mice, and 3 or 4 days later maleic acid and x rays were given. The frequency of mitosis, the difference of each mitotic phase in number, and the frequency of abnormality of chromosomes in metaphase and anaphase were investigated. When 0.04 mg of maleic acid per 100 g weight was given to the mice there was no change in the frequency of mitosis. On injecting 5 mg of maleic acid per 100 g body weight there was a slight decrease in mitosis soon after injection; after 9 to 12 hr it was found that there was a 40% increase in the frequency of mitosis. On injecting both quantities, 0.04 mg and 5 mg of maleic acid, there was little marked transformation in morphology. Injection of maleic acid after x irradiation showed no observable protective effect. Maleic acid had a protective effect on malonate which would inhibit the activity of mitotic cells, but in this case maleic acid had no restorative effect. One hour after injection of maleic acid, the effect of malonate and the combined use of x rays was protective on mitosis but not restorative. It was concluded that maleic acid like fumaric acid exerted some influence on the pathway between succinic acid and fumaric acid, and that maleic acid had a protective effect against x irradiation. (Abstr. Japan Med., 1: No. 15, 1961)

8605 INFLUENCE OF IRRADIATION UPON THE SKIN pH. T. Miyamoto (Kyoto Prefectural Univ. of Medicine). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2723-36(1961).

A new type of glass electrode was made to measure skin pH. By means of this electrode skin pH values were measured in rabbits after either whole-body or local irradiation of 450 r. Diminution of pH values of the skin after irradia-

tion was not reduced progressively but by 3 small wave-like alterations of pH, which were observed for 60 min. Diminution of pH value after irradiation was independent of the dosage administered, but the larger the dose the longer was the period during which the diminished stage of the primary pH continued. (Abstr. Japan Med., 1: No. 15, 1961)

8606 THE INFLUENCE OF X-RAY IRRADIATION ON THE LIVER CATALASE ACTIVITY. T. Yanagisawa, N. Hiramatsu, Z. Iwasaki, and H. Toda (Iwate Medical Coll., Morioka, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2766-70(1961).

After whole-body exposure of 1000 r x rays, liver catalase activity of mice was decreased for several days. The catalase activity was decreased also after intraperitoneal administration of liver extract, urine, and serum prepared from the animal irradiated by x rays. Therefore, it is suggested that the substance inhibiting liver catalase of mice is contained in the liver, urine, and serum of irradiated animals. The significant decrease of liver catalase activity after irradiation might be due to the catalase inhibitory substance in the blood stream. (Abstr. Japan Med., 1: No. 15, 1961)

8607 INFLUENCE OF X-IRRADIATION AND NITROMIN ON ACID PHOSPHATASE IN YOSHIDA ASCITES SARCOMA. K. Nagase and M. Takeuchi (Juntendo Univ. School of Medicine, Tokyo). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2801-8(1961).

The influence of x irradiation and nitromin on Yoshida ascites sarcoma, and its relation to the mitotic index and to the rise and fall of acid phosphatase in the resting cells (II form) was studied. The positive rate of acid phosphatase was decreased with the diminution of the mitotic index. The positive rate of acid phosphatase in the resting cells was also decreased, and it is suggested that these findings are related to internal and external regenerations. (Abstr. Japan Med., 1: No. 15, 1961).

8608 SIGNIFICANCE OF THE ABSORBED DOSE IN THE DEVELOPMENT OF TUMORS INDUCED BY RADIOACTIVE SUBSTANCES. E. Ya. Smoilovskaya (Inst. of Experimental Pathology and Therapy and Inst. of Oncology, Academy of Medical Sciences, USSR). Problems Oncol. (U.S.S.R.) (English Translation), 7: No. 4, 37-43(1961).

Seven blastomas developed in 6 of 14 female rats in whom 1 mc of Zn^{65} had been implanted in the mammary region. No malignant tumors were found in six males in the same series of experiments. The optimum doses for tumor formation were absorbed doses of the order of several tens of thousands of rads, whereas maximum doses (of the order of many millions of rads) caused only necrosis. A dose of the order of one to two thousand rads occasionally induced a mammary adenocarcinoma. In the series with Ag^{110} used in a glass filter, three out of 15 surviving female rats developed mammary adenocarcinomas after exposure to gamma radiation in doses of the order of several tens of thousands of rads, which coincides with the results in the Co^{60} series described in an earlier report. The insertion of beta emitters in paraffin tablets near the mammary glands proved to be less effective. Occasional mammary adenocarcinomas were noted after implantation of tablets with Ca^{45} and W^{185}. The development of two distant blastomas after subcutaneous implantation of tablets (thigh sarcoma caused by Ca^{45} and malignant ovarian thecoma caused by S^{35}) shows the possibility of isotope resorption from the paraffin tablet and inclusion of the radioactive substance in metabolism. The frequency with which we observed hyperplasia in the ovaries of the rats indicates that hormonal dysfunction resulting from impaired ovarian function acted as a co-carcinogenic factor. (auth)

8609 DEVELOPMENT OF RESISTANCE TO STREPTOMYCIN BY BACT. LACTIS AEROGENES (AEROBACTER AEROGENES). III. RESPONSIBILITY OF RADIATION FOR NATURALLY OCCURRING MUTANTS. W. T. Drabble and Cyril Hinshelwood (Oxford Univ.). Proc. Roy. Soc. (London), B155: 433-6(Jan. 9, 1962).

Cultures derived from single colonies of Bact. lactis aerogenes, isolated in the dark, contain a greatly reduced proportion of first-stage streptomycin-resistant mutants. When continuously grown with normal exposure to all natural radiations the cultures regain the normal proportion much more rapidly than if screened with lead. (auth)

8610 A BIOPHYSICAL CONSIDERATION ON RADIATION MUTAGENESIS. Sohei Kondo (National Inst. of Genetics, Misima, Japan). Progr. Theoret. Phys. (Kyoto), Suppl. No. 17, 129-42(1961). (In English)

A perspective picture is presented of radiation mutagenesis and the sequence of events which leads from the absorption of radiation to the eventual recovery of mutants. A model of the mechanism of mutational events in microorganisms modifiable by postirradiation treatments is proposed and applied to the interpretation of the differences in mutation rate at various stages of germ cells of a higher organism, the silkworm. (auth)

8611 INTERVARIETAL DIFFERENCE OF RADIOSENSITIVITY TO PILE RADIATION IN RICE. Hikoyuki Yamaguchi and Masashi Kobayashi (Tokyo Univ.). Radioisotopes (Tokyo), 10: 322-8(Sept. 1961). (In Japanese)

A comparison is given on the radiosensitivity of different varieties of rice in order to obtain information concerning the use of ionizing radiations for genetic modification. In all instances seedling height is used as a criterion of radiosensitivity to pile radiation. Results show that Japanese rice is comparatively susceptible to pile radiation in comparison with foreign varieties, and tetraploids are less damaged as compared with the diploid varieties. Hybrids from crossed rice also show remarkable differences. The results also show that in addition to the contribution of a gene or a gene system the cytoplasm is related to the intervarietal difference of radiosensitivity. (N.W.R.)

8612 EFFECTS OF X-RADIATION ON GROWING BONE. A PRELIMINARY REPORT. Howard J. Barnhard and Robert W. Geyer (Univ. of Arkansas, Little Rock and Hahnemann Medical Coll. and Hospital, Philadelphia). Radiology, 78: 207-14(Feb. 1962).

The epiphyseal lines of young dogs were exposed to x-ray doses of approximately 2000 r. A special unit permitted selection of treatment fields from a few square millimeters up. The usual effect was a faint, then more pronounced increase in density of that portion of the metaphysis included in the field of irradiation. The density appeared in one to two days and was followed by cessation of growth in another one to two days. The unirradiated part of the epiphyseal line continued to grow. As long as the mechanical stability of the distal epiphysis on the metaphysis was unaffected, the bone would largely reconstruct itself. A variation in sensitivity of different portions of the same epiphyseal line may exist. (auth)

8613 REFRIGERATION AND IRRADIATION: LOWERING THE SKIN TEMPERATURE OF THE IRRADIATED FIELD. Edwin J. Liebner, Walter S. Moos, Martin Hochhauser, and Roger A. Harvey (Univ. of Illinois, Chicago). Radiology, 78: 258-9(Feb. 1962).

Lowering the skin temperature to 50 to 55°F locally, during irradiation with factors of 300 kv and h.v.l. of 4 mm Cu, results in skin sparing (less desquamation and atrophic changes), the possibility of additional dosage with increased depth dose, and less discomfort to the patient locally. These benefits can also be important to younger patients and to those treated with electron beams or with drugs (actinomycin D). Better use can be made of conventional machines if a supervoltage unit is not available. (auth)

8614 POST-IRRADIATION HYPERLIPEMIA. Maurice L. Bogdonoff (Presbyterian-St. Luke's Hospital, Chicago). Radiology, 78: 263-5(Feb. 1962).

The previously documented hyperlipemia following whole-body irradiation was confirmed in rabbits and in dogs. It was demonstrated that the hyperlipemia tends to remain or to rise slightly over one year. The hyperlipemia is not correlated with blood sugar or with blood urea nitrogen determinations. No correlation can be established with the erratic changes in isocitric dehydrogenase, serum glutamic-oxalacetic transaminase, and serum glutamic-pyruvic transaminase. In addition, hyperlipemia was obtained following segmental irradiation, including localized irradiation to the head. The nature and duration of these types of hyperlipemia may shed light upon some of the factors controlling fat metabolism. (auth)

8615 COMPARISON OF THE EFFECT OF COBALT-60 AND 250-kv RADIATION ON THE BONES OF THE RAT. M. N. Lougheed and B. St. J. Brown (Montreal General Hospital). Radiology, 78: 278-80(Feb. 1962).

Stunting of bone growth from irradiation appears in rats and can be evaluated experimentally. The stunting increased markedly when the dose was raised from a single dose of 1000 to 2000 r. The 250-kv irradiation produced more stunting than an equivalent dose of Co^{60} irradiation. The lowest dose at which measurable stunting appears was not determined, nor was the precise "stunting equivalent" of the two modalities established. (auth)

8616 EVALUATION OF CALCIUM 47 IN NORMAL MAN AND ITS USE IN THE EVALUATION OF BONE HEALING FOLLOWING RADIATION THERAPY IN METASTATIC DESEASE. Luther W. Brady, Millard N. Croll, Leonard Stanton, David Hyman, and Steven Rubins (Hahnemann Medical Coll. and Hospital, Philadelphia). Radiology, 78: 286-8(Feb. 1962).

It was concluded that radioactive Ca^{47} is an isotope suitable for the study of calcium metabolism in the body. It is easily traced by external counting technics. Local uptake measurements as well as ratios over various areas of the skeleton can be determined, thus yielding useful diagnostic information. It is a safe agent for use. It is possible to differentiate normal bone from areas of diseased bone using it. It is not useful for scintiscanning. It is grossly applicable in the evaluation of effects of radiation therapy to local metastatic lesions in bone. These observations support the fact that bone-seeking isotopes may well be useful as diagnostic agents for the evaluation of subradiographic metastases. (auth)

8617 IRRADIATION OF BACTERIAL LUCIFERASE IN VIVO. C. H. Burns, A. D. Nevill, and G. H. Whipple (Univ. of Michigan, Ann Arbor). Science, 135: 430-2 (Feb. 9, 1962).

The fading of in vivo luminescence, which is characteristically displayed by resting cell suspensions of the luminous bacteria Photobacterium fischeri is partly accounted for by a gradual loss of active luciferase. This luminescence is further diminished by exposure of such suspensions to gamma radiation, but the irradiated cells yield more, rather than less, active luciferase than do cells of the non-irradiated suspension. These and similar results with menadione-treated cells indicate that, while luciferase is gradually inactivated by its catalysis of light production, it can resist inactivation by radiation better than can some component of its supporting metabolism. (auth)

8618 NEW DATA AND SIGNIFICANCE OF THE RELATIVE RADIATION RESISTANCE OF GENETIC MATERIALS IN THE MATURE SPERM AND THE PRIMORDIAL CELLS. Hedi Fritz-Niggli (Radiotherapeutische Klinik des Kantosspitals, Zurich). Strahlentherapie, 116: 340-53(Nov. 1961). (In German)

It was shown that environmental effects depend upon the age of the genetic cell, and the sensitivity pattern depends on mutation type using an example of radiation induction of chromosome (piece) loss in different development stages of male drosophila under different irradiation conditions (air, N_2, CO, O_2). The difficulties of judging the effect of environmental factors are discussed. The reasons that these difficulties arise are, that radiation has a cytoclastic effect, and the environmental factors are able to change the metabolism as well as the vitality of the cells (pseudo-sensibilization and pseudoprotection). In addition to the low O_2 level, water dificiency of the intrachromosomic environment must be responsible for the relative resistance of the genetic material in the mature sperm and in the primordial cells. (auth)

8619 POSSIBILITIES OF THE INTERVENTION OF SENSITIZING AND DESENSITIZING ADDITIONS IN RADIOBIOLOGY AND RADIOCHEMISTRY. III. THE MODIFICATION OF THE RADIOSENSITIVITY AND TUMOR GROWTH BY CHOLESTERIN AND CHOLESTERIN-HYDROPEROXIDE. Ruprecht Koch and Guenther O. Schenck (Universität, Freiburg i. B. and Max-Planck-Institut für Kohlenforschung, Mulheim/Ruhr, Ger.). Strahlentherapie, 116: 364-73(Nov. 1961). (In German)

On whole-body irradiated rats, cholesterine and Δ^6-cholesten-3β-ol-5α-hydroperoxide show a significant radiation protective effect. That of cholesterin-hydroperoxide is greater than that of cholesterine. A clarification of the effect is, at the moment, not possible. After an observation period of 2 years irradiated cholesterine animals show a tumor induction rate of 17.4%, cholesterin-hydroperoxide animals, under similar conditions, an induction rate of 9.5%. Both values are not significantly different. All further findings show, that quite clearly Δ^6-cholesten-3β-ol-5α-hydroperoxide is not a cancerogenous substance. (auth)

8620 INVESTIGATIONS ON THE GENESIS OF THYMUS ATROPHY AFTER X RADIATION. I. ORGAN WEIGHT AND HISTOLOGICAL MODIFICATIONS AFTER WHOLE-BODY IRRADIATION. Ulrich Hagen and Hildegard Braun (Universität, Freiburg i. B. and Heiligenberg-Instituts, Heiligenberg, Ger.). Strahlentherapie, 116: 374-84(Nov. 1961). (In German)

The thymus of many rats was investigated to determine the ratio of injured and uninjured cells within the first 24 hours after whole body irradiation with 1000 r. This has been done to find fundamental rules for the biochemical investigations about the cell death after x-ray irradiation. The thymus loses weight rapidly after a latent time of 3 hours. This first weight loss down to 70% of the control is completed after 6 to 8 hours. A second, slower weight loss starts 12 hours after the irradiation, lasting 3 to 4 days. Counting of the uninjured and the pycnotic cell nuclei in the medulla and cortex of the organ shows, that the first

weight loss is caused by emigration of apparently uninjured cells; the second loss is caused by gradual fragmentation of the dead cells. The pycnosis of the cell nucleus, which is a distinct visible sign of the cell death does not start immediately after the irradiation. There is a latent time of about 2 hours. All those cells, which were injured irreversibly by the radiation energy show a pycnotic nucleus 6 hours after the irradiation. (auth)

8621 INVESTIGATIONS ON THE GENESIS OF THYMUS ATROPHY AFTER WHOLE-BODY IRRADIATION. II. THE FATE OF DESOXYRIBONUCLEIC ACID. Ulrich Hagen (Universität, Freiburg i. B. and Heiligenberg-Instituts, Heiligenberg, Ger.). Strahlentherapie, 116: 385-94(Nov. 1961). (In German)

Desoxyribonucleic acid (DNA) concentrations of the thymus tissue during the first 18 hours after a whole body irradiation with 1000 r are reported. The DNA concentration is unchanged during the first 12 hours, although many cells of this organ are already damaged irreversibly. The measured decrease of the DNA content after 18 hours is based on a changed compositon of the cells of the thymus. The structure of the DNA, however, is damaged very early after irradiation. The viscosity of the DNA decreases considerably within 3 hours after the irradiation. It can be concluded that there is a degradation of the chain of the molecule. The decrease of viscosity takes place simultaneously with the histologic appearance of pycnosis of the cell nucleus. It is assumed that the degradation of the DNA is caused by the necrolytic processes which begin after the cell death. It is less likely, however, that the chain of the nucleic acid is destroyed directly by radiochemical processes during the whole body irradiation. (auth)

8622 INVESTIGATIONS ON A BIOLOGICAL RADIATION PROTECTION. XLIV. THE THERAPEUTIC EFFECT OF SPLENECTOMY ON RADIATION DAMAGE. Hans-Joachim Melching, Otfried Messerschmidt, Christian Streffer, and Kyoko Shibata (Universität, Freiburg i. B.). Strahlentherapie, 116: 395-403(Nov. 1961). (In German)

The distinct therapeutic influence of splenectomy on the radiation injury, observed 6 hours after a sublethal whole body irradiation of white mice, is reported. An investigation of the splenic tissue for the content of metabolites of cysteine (cysteine sulfinic acid, cysteic acid, and taurine) within the first 12 days after irradiation showed a distinct increase of the cysteic acid. The possible connections between radiation injury and splenectomy, as well as the biochemical changes in the splenic tissue, are discussed. (auth)

8623 MODEL RESEARCH ON CHEMICAL RADIATION PROTECTION. II. PROTECTIVE EFFECT OF MATERIALS CONTAINING THE SULFHYDRYL GROUP AGAINST PERMEABILITY PERTURBATIONS IN X-IRRADIATED ERYTHROCYTES. Kurt Flemming (Universität, Greifswald, Ger.). Strahlentherapie, 116: 404-14(Nov. 1961). (In German)

Several SH compounds and their corresponding SH free control compounds were investigated for their radiation protection effect using alteration of permeability of the erythrocytes membrane (swelling and potassium-sodium exchange) and the hemolysis caused by x rays. The SH group is of decisive importance for the protection effectiveness of the investigated SH compounds (cysteine, homocysteine, cysteinamine, glutathione, sodium thioglycholate, and monothioglycerine). The contemporary presence of the NH_2 group in the molecule has no special influence on the protection effect of these substances. The investigated SH compounds show, in higher concentrations (3×10^{-2} mol), a hemolyzing effect with varying strength for each compound. This effect is greater in the x-ray irradiated erythrocytes than in the unirradiated ones. The hemolyzing effect of SH compounds can cover or sometimes completely annul the radiation protection effect. The protection effect against x-ray hemolysis is caused by the reduction ability of the SH compounds. They attract oxidizing radicals, which are produced by the irradiation, from the erythrocyte membrane by means of their greater oxidation tendency. The effect found with x-ray hemolysis does not agree, in all cases, with the effect in the whole animal as reported in the literature. Therefore, it is assumed, that, under the conditions of the whole animal experiment, still other factors besides the radical capture are important for the protection effect. (auth)

8624 THE EFFECT OF CYSTEINE ON THE RADIO-INDUCED MODIFICATIONS OF THE ADENINE-NUCLEOTIDE CONTENT IN VARIOUS ORGANS OF THE RAT. Heinrich Maass and Hans-Herbert Adler (Universitäts-Frauenklinik, Hamburg). Strahlentherapie, 116: 435-42 (Nov. 1961). (In German)

It is shown that the application of cysteine before irradiation prevents radiation induced changes completely in the liver, partly in the spleen and the thymus. In spleen and thymus, however, there is a faster normalization of the values than in unprotected animals. From this it is concluded that the inhibition of oxidative phosphorylization can be prevented by the application of cysteine. The changes of adenine-nucleotide content of spleen and thymus, especially the ATP loss, are partly explained by the occurrence of cell death. As is well-known, these morphological changes, which can be determined early, cannot be influenced by protective SH substances. (auth)

8625 THE EFFECT OF EXOGENIC AND ENDOGENIC FACTORS ON THE RADIATION REACTION OF THE SKIN. V. ENZYMATIC AND FERMENTHISTOLOGICAL INVESTIGATIONS ON RABBIT SKIN AFTER LOCAL IRRADIATION AND INTERNAL INFLUENCE OF VARIOUS SUBSTANCES. Karl Heinz Kaercher (Universität, Heidelberg, Ger.). Strahlentherapie, 116: 448-62(Nov. 1961). (In German)

It was observed that those substances which influence the dynamics of reactive inflammation are of special use for the enzymatic and enzyme-histochemical investigations of radiation reaction in the rabbit skin under internal influence of several agents. Cortisone and chamazulen slightly retarded healing, while vitamin P 4, heparin, and hyaluronidase accelerated healing in contrast to the controls. The reasons for the effect of the described substances are discussed. (auth)

8626 SURVIVAL OF RAT SKIN GRAFTS ON LETHALLY IRRADIATED CBA MICE RESTORED WITH CBA FOETAL LIVER. H. S. Micklem (Medical Research Council, Harwell, Berks, Eng.). Transplantation Bull., 29: 7-9(Jan. 1962).

CBA mice lethally irradiated and restored with CBA fetal liver were grafted orthotopically on the day of irradiation with rat skin. Eleven of the grafts survived long enough to grow characteristic rat fur and were shed between 5 and 9 weeks after grafting. Eleven grew no hair, but survived at least partially for a similar period. Only 2 were shed in less than 30 days. This was in sharp contrast to grafts on irradiated mice restored with adult bone marrow, none of which survived for longer than 30 days. (auth)

8627 ELIMINATION OF RUNT DISEASE AND INDUCTION OF ACQUIRED TOLERANCE BY X-IRRADIATED SPLEEN CELLS. Bertie F. Argyris (Syracuse Univ., N. Y.). Transplantation Bull., 29: 10-12(Jan. 1962).

X irradiation of CBA donor mice with 400 r inhibits antibody production to tissue antigens, as measured by the elimination of runt disease in C57BL/6 mice. Irradiation does not eliminate the capacity of the spleen cells to produce acquired tolerance in newborn C3H mice. (auth)

8628 THE IMMUNOLOGIC AND HEMATOLOGIC STATUS OF RABBIT RADIATION CHIMERAS. Marcus S. Brooke and Fred Lee (Harvard Medical School and Peter Bent Brigham Hospital, Boston). Transplantation Bull., 29: 12-16(Jan. 1962).

The immunologic and hematologic picture were compared in irradiated rabbits and in rabit radiation chimeras resulting from the injection of bone marrow from young females of the same strain. Results are tabulated and discussed for hemagglutination tests against bovine gamma globulin, skin tests against tuberculin, the phagocytosis of S. albus by cellular exudates, and hematological findings. (C.H.)

8629 VLIYANIE IONIZIRUYUSHCHIKH IZLUCHENII NA NERVNUYU SISTEMU. (Effects of Ionizing Radiation on Nervous System). A. V. Lebedinskii and Z. N. Nakhil'-nitskaya. Moscow, Atomizdat, 1960. 188p.

The discovery of nervous system reactions to ionizing radiation and methods for their investigation are reviewed. The method of Pavlov's conditional reflex for determining radioinduced disturbances of cortex functions, electrophysiology, changes in intracentral relations in reticular substances, and diencephalic and mesencephalic vegetative centers are discussed. Data are also presented on changes in the central nervous system which do not depend on vascular disturbances, however, the nature of the initial physiological disturbance in the nerve cells is not known. The data are confined to the concept of neuron neucleonic exchange. It is postulated that a process identical to the appearance of strong depolarization of synaptic formation may take place in the neuron body. 512 references are included. (R.V.J.)

Radiation Sickness

Refer also to abstract 9018

8630 (JPRS-11848) SELECTED ARTICLES ON RADIATION SICKNESS, IONIZING RADIATION, AND THE EFFECT OF RADIOACTIVE IODINE. Translated from Arkh. Patol., 23: No. 8, 24-49(Aug. 1961). 49p.

Four papers are included on the effects of radiation sickness on the vascular system, pneumonia, and salivary glands and the effects of I^{131} on the thyroid. Separate abstracts were prepared for all four papers. (D.L.C.)

8631 (JPRS-11848(p.1-12)) PATHOMORPHOLOGY OF THE VASCULAR SYSTEM IN ACUTE RADIATION SICKNESS. N. E. (Ye.) Yarygin and G. M. Nikolaev (Nikolayev). Translated from Arkh. Patol., 23: No. 8, 24-31(Aug. 1961).

Thirty-two dogs were exposed to 600-r x-ray doses and structural changes in the blood vessels of various internal organs were studied at various times after irradiation. Mild morphological changes in the vessels appear as early as the first few days of radiation sickness and increase to reach their maximum at the height of radiation sickness. Functional stress from physical exertion increases the severity of vascular changes and contributes to early death. In the neural apparatus of the heart and aorta, morphological changes behave similarly to these in the blood vessels. In the course of recovery from radiation sickness, a moderate sclerosis develops, and after recovery, dystrophic changes are manifested in the neural vascular elements. (D.L.C.)

8632 (JPRS-11848(p.13-24)) STAPHYLOCOCCUS PNEUMONIA IN RADIATION SICKNESS. O. I. Bazan. Translated from Arkh. Patol., 23: No. 8, 32-8(Aug. 1961).

Eighty-five rabbits irradiated with 300 to 700 r x rays were infected with Staphylococcus aureus under various conditions and the subsequent morphological changes in the lungs investigated. Staphylococcus pneumonia in irradiated rabbits was characterized by sero-hemorrhagic exudates, deficiency of leucocytes in the inflammatory exudate, and a large number of staphylococci in the focus of inflammation. In the presence of a large number of staphylococci, the process often assumed a necrotic character with vascular thrombosis, hemolysis, and pasting of erythrocytes. The macrophage tissue reaction, epithelization of alveoli, and the development of granulation tissue were observed during remote periods of the disease and were only slightly impaired at a given irradiation dose. The remote periods of the disease were characterized by a wave-like nature of the process, always with the presence of progressive foci of inflammation. The disease had a severe course which usually led to generalization of the process and ended in death. Antibiotic therapy of staphylococcus pneumonia in irradiated animals gave positive results and indicates a means of prevention and treatment of pneumonia in radiation sickness. (D.L.C.)

8633 (JPRS-11848(p.25-33)) CHANGES IN THE PAROTID GLANDS UNDER REPEATED EXPOSURES TO IONIZING RADIATION. A. A. Prokhonchukov and V. V. Panikarovskii (Panikarovskiy). Translated from Arkh. Patol., 23: No. 8, 39-43(Aug. 1961).

Sixty-eight rats with controls were irradiated three times a week with 50-r x-ray doses to total doses of 300 to 3500 r and morphological changes in the salivary glands investigated together with other studies of the rats, e.g., weight, leucocytes, internal organs, etc. The experiments revealed regular phasic changes in the parotid glands. The first phase (300 to 2000 r) is characterized by functional activity of the secretory cells of the parotids. The cells are filled with secretion granules, and the excretory ducts are dilated. The morphological parenchymatous changes at this phase are slight. Plethora, edema, and swelling of the tissue are noted. The second phase (2200 to 3500 r) reveals discomplexation of the parotid alveoli, an enlargement of the cells, and their vacuolization. A deficiency of cells of the end parts in secretory granules is noted. Most pronounced changes are observed in the cells of the secretory glands. Their nuclei grow in size, are polymorphous, hyperchromic, often reveal caryokinetic figures of pathological nature. In many nuclei, there are numerous small transparent vacuoles or one large vacuole which occupies the major part of the nucleus. Morphological changes of the glandular parenchyma at this phase are of a stable, irreversible nature. The development of morphological changes in the parotid gland under conditions of repeated exposures is somewhat analogous to reported single exposures but possesses a number of special features. (D.L.C.)

8634 (JPRS-11848(p.34-45)) SECONDARY CHANGES IN THE THYROID FOLLOWING THE ACTION OF RADIO-

ACTIVE IODINE. Yu. V. Krivobok. Translated from Arkh. Patol., 23: No. 8, 44-9(Aug. 1961).

Single injections of one microcurie I^{131} each were carried out on sexually mature white male rats and the rats studied at time intervals up to 240 days after injection. The variables studied were raw and dry weights of the thyroids, height of follicular epithelium cells, sorption intensities, isoelectric points of thyroid cells, and structure of thyroids. The wave-like response reactions to the I^{131} radiation can be divided into three basic periods. During the second period, an increase in amitotic activity of the epithelium leads to the genesis of giant symplastic formations in the thyroid. It is concluded that one microcurie of I^{131} is not absolutely harmless to the rat thyroid. (D.L.C.)

8635 (JPRS-11942) THE CHEMICAL PROPHYLAXIS OF RADIATION SICKNESS. A. S. Mozzhukhin and F. Yu. Rachinskii (Rachinskiy). Translation of a booklet "Khimicheskaya Profilaktika Luchevoy Bolezni" Leningrad, 1960. 29p.

The mechanisms governing radiation damage to organisms, by sources external or internal to the organism, are studied, and chemicals that afford prophylactic relief from this damage are examined. In addition, the use of the disodium salt of EDTA in the therapeutic treatment of internally located radioisotopes is described. The damaging effects of α and β radiation, photons, and neutrons are considered. (T.F.H.)

8636 MARROW TRANSPLANTS IN LETHALLY IRRADIATED DOGS GIVEN METHOTREXATE. E. Donnall Thomas, John A. Collins, Emery C. Herman, Jr., and Joseph W. Ferrebee (Mary Imogene Bassett Hospital, Cooperstown, N. Y.). Blood, 19: 217-28(Feb. 1962).

The antimetabolite Methotrexate was tested in 41 dogs that received 1200 to 1600 r of whole-body irradiation followed by infusions of homologous marrow. The clinical and hematologic events in these animals are described. Five dogs given Methotrexate following irradiation lived beyond four months and appeared to have survived the period of secondary syndromes. (auth)

8637 A NEW BIOLOGICAL PRINCIPLE OF RADIATION PROTECTION. A. N. Studitskii (Severtsov Inst. of Animal Morphology, Academy of Science, USSR). Doklady Akad. Nauk S.S.S.R., 141: 976-9(Dec. 1, 1961). (In Russian)

The plastic state is an important biological property of tissue. It is characterized by an ability to pass to a lower level of differentiation, by a decrease in functional activity, and by an increase in content of RNA. Thus, tissues which are being regenerated after a mechanical injury such as a surgical operation become radioresistant. Thus, tibia were removed from both extremities of 10 white rats by surgical operation. At the height of the reparative processes (17 days after the operation) the rats were subjected to a total x-ray irradiation of 500 r. Only one rat died in 30 days (20%). With a dose of 600 r, three out of 13 rats (23% deaths) died. The control groups showed 54% and 63.6% deaths. Thus, changes, taking place in tissue as a result of mechanical damage, weaken the harmful effects of ionizing radiation. The presence of young, highly proliferating tissues impart radioresistance to an organism, and can be used to accelerate regenerative processes which combat the harmful effects of radiation. (TTT).

8638 LEUCON (ADENINE DERIVATIVE) APPLIED TO RADIATION BLOOD INJURIES. H. Hirano (Neitetsu Hospital, Nagoya, Japan). Gan no Rinsho, 7: No. 4, 248-51 (1961).

Leucon (adenine derivative) was applied in the treatment of 9 patients whose leukocytes were markedly decreased in numbers. No ill effects were observed. The administration of 40 mg of leucon every day had a favorable effect on the leukopenia, whereas a larger dose of it would be needed for the more intensely irradiated cases. In some cases, leucon rather increased the number of leukocytes beyond the normal level. There was no difference in the effect of the per os and intravenous administration of leucon. (Abstr. Japan Med., 1: No. 15, 1961)

8639 THE PROTECTIVE EFFECT OF PRELIMINARY IMMUNIZATION OF ANTIBODY SYNTHESIS IN TOTAL X-RAY IRRADIATION. M. I. Ravich-Shcherbo and L. G. Prokopenko (Kursk Medical Inst., USSR). J. Microbiol., Epidemiol. Immunobiol. (U.S.S.R.) (English Translation), 31: 2262-8(1960).

Immunization with heated paratyphoid B vaccine, carried out before irradiation of rabbits (600 r), normalized the synthesis of antibodies to human serum injected 24 hours after irradiation. The same protective effect was observed with the reverse schedule of immunization. Where rabbits were injected simultaneously with two antigens 24 hr after irradiation, the synthesis of antibodies to both antigens was disrupted. Preliminary injection of a foreign protein may be regarded as an unspecific factor facilitating normalization of the immunogenetic processes in cases of radiation sickness. (auth)

8640 INFLUENCE OF BLOOD TRANSFUSIONS ON IRRADIATED RATS. M. Skalka (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Nature, 193: 340-1(Jan. 27, 1962).

Male and female adult Wistar rats weighing 200 to 300 g were given whole-body x irradiation. From the 4th to 5th day to the 20th to 24th day, the animals were given a daily (not Sundays) intramuscular dose of antibiotics (20 mg streptomycin and 24000 units of penicillin per rat). Starting from the 6th to 9th day the rats were given, daily or every other day up to the 15th to 20th day, an intravenous transfusion of 2 to 4 ml suspension of washed fresh rat blood cells in saline with a hematocrit of approximately 40%. After repeated transfusions unfavorable reactions were not observed in irradiated or unirradiated control animals. Repeated red blood cell counts showed that transfusions were effective since they maintained the number of erythrocytes at a high level. It was concluded that the administration of blood transfusions to rats treated with antibiotics considerably increased their survival-rate and time. It is also suggested that death of some of the rats at the time of post-irradiation bone marrow syndrome was due not only to bacteriemia and sepsis; further important factors (in some species) were severe anemia and ensuing tissue anoxia. (P.C.H.)

8641 EXPERIMENTAL STUDIES ON THE PREVENTION AND ONSET OF RADIOLOGICAL PULMONARY INJURY. K. Ozawa (Kobe Medical Coll., Kobe, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 907-26(1960).

Retrogressive changes in the bronchial lymph nodes and in the bronchial cartilage, thickening of the septa of alveolar vesicles, of the intima and media of the pulmonary and bronchial vessels, obstruction or stenosis of the vascular canal, perivascular and bronchial round cell infiltration, and regressive changes in the bronchial epithelial cells and vesicular epithelium were seen in rabbits after x irradiation of 4000 to 10000 r to the thorax. The radiation injury was markedly reduced as to both onset and development after daily administration of epirenamine hydrochloride (0.05 mg/kg), benzilimidazoline hydrochloride (5.0 mg/kg), acetylcholine chloride (0.5 mg/kg), tetraethylammonium chromide (25.0 mg/kg), chlorpromazine hydrochloride (2.5

mg/kg), or dihydrooxypropyltheophylline (75.0 mg/kg). (Abstr. Japan Med., 1: No. 15, 1961)

8642 THE EFFECT OF CHEMICALS ON THE LIVER OF IRRADIATED MICE. A. Kono (Yamaguchi Prefectural Medical School, Ube, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1574-85(1960).

Male mice were exposed to whole-body x irradiation of 550 r (160 kv, filter 0.5 mm Cu and 0.5 mm, Al, 18.6 r/min), and cysteine, politamin, guronsan, pereston-N, or nagravon was injected immediately after irradiation. After staining with methyl green pyronin the livers were examined histologically. Changes of RNA and nuclear DNA in hepatic cells were used as indicators of radiation injury. Cysteine, moriamin S, politamin, pereston-N, and guronsan, but not nagravon, retard the appearance of morphological changes of RNA and DNA due to irradiation, and accelerate the disappearance of the changes. It is concluded that these agents have a protective action on radiation injury. (Abstr. Japan Med., 1: No. 15, 1961)

8643 EFFECTS OF THE ADRENOCORTICAL HORMONE ON THE PULMONARY LESION IN RABBITS CAUSED BY X-RAY IRRADIATION. Y. Tukioka (Gifu Prefectural Medical Univ., Gifu, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2771-88(1961).

When adrenocortical hormone was administered in the course of or after x irradiation, the changes in the lung of rabbits such as increased interalveolar cells, interalveolar sclerosis, and interstitial sclerosis as well as regeneration and proliferation of the bronchial epithelium were more or less depressed. However, new bone formation was observed more frequently in the interalveolar lumina. There was no obvious evidence of atrophic changes in the blood vessels and cartilages. There were no histological effects on the lung, when the hormones were administered a relatively long time following irradiation. (Abstr. Japan Med., 1: No. 15, 1961)

8644 RELATIVE INABILITY OF AET AND APMT TO PROTECT IMMUNOLOGICALLY COMPETENT CELLS AGAINST RADIATION INJURY. Gustavo Cudkowicz (Oak Ridge National Lab., Tenn.). Transplantation Bull., 29: 19-22(Jan. 1962).

The radio-protective drugs AET and APMT did not protect immunologically competent cells in adult mouse liver against radiation injury, as judged by the ability of the irradiated cells to induce wasting disease in parent-to-F_1 hybrid radiation chimeras. This result suggests a method for selective destruction of immune cells in tissues to be transplanted. (auth)

8645 DIAGNOSIS AND TREATMENT OF ACUTE RADIATION INJURY. Proceedings of a Scientific Meeting, Geneva, 17-21 October 1960. (World Health Organization, Geneva). 1961. 425p. $8.00(WHO).

Separate abstracts were prepared on the 20 papers presented at this conference. (C.H.)

8646 THE LOCKPORT INCIDENT: ACCIDENTAL PARTIAL BODY EXPOSURE OF HUMANS TO LARGE DOSES OF X-IRRADIATION. J. W. Howland (Univ. of Rochester, N. Y.), M. Ingram, H. Mermagen, and C. L. Hansen. p.11-26 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961.

Nine individuals were exposed to ionizing radiation from an unshielded klystron tube at a military installation in Lockport, New York. Two of the exposed men were seriously injured, 5 demonstrated less severe damage, while 2 remained asymptomatic throughout the entire period of observation. The shielding of greater or lesser areas of the body in the men working closest to the tube was shown to be of critical importance in the degree of radiation injury received. The conditions of exposure are described and preliminary calculations of dosimetry are presented. General symptomatology, clinical, and laboratory findings on the most seriously injured casualty are given in detail. A few unusual observations on other casualties are also included. (auth)

8647 THE ASSESSMENT OF ACUTE RADIATION INJURY. Louis H. Hempelmann (Univ. of Rochester, N. Y.). p.49-66 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961.

A brief account is presented of the main clinical features of patients injured in the 1945 and 1946 accidents at the Los Alamos Scientific Laboratory. It is concluded that there are no dependable biological indicators of the severity of illness in patients who have been exposed to radiation doses in or near the lethal range. The severity of the illness can be assessed only by comparing the response of the patient with that of other patients previously exposed under similar conditions. The excretion of β-aminoisobutyric acid and taurine and changes in the mitotic indices of bone marrow offer the most reliable indication of the severity of radiation injuries. (C.H.)

8648 THE ZERO-ENERGY REACTOR ACCIDENT AT VINČA. Branislav Pendic ("Boris Kidrich" Inst. of Nuclear Sciences, Belgrade). p.67-81 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961.

On October 15, 1958, the zero-energy reactor at Vinča, Yugoslavia, became supercritical, with the result that 6 men were exposed to irradiation with neutrons and γ rays. The personal dose meters, film badges, and pocket meters worn by the exposed persons were completely saturated. In order to determine the doses of radiation received by the victims, measurements were made of the induced activity of metal objects such as rings, pens, and coins carried by the exposed persons, and of the induced Na^{24} activity in the irradiated persons made with a 25-channel γ spectrometer. Data are tabulated. The total estimated dose received ranged from 350 to 640 rad. The clinical picture, biochemical findings, hematological changes, hemostatic disturbances, visceral and genital disturbances, and response of the patients to bone marrow transfusions are described. The value of early clinical signs, such as nausea, vomiting, diarrhea, and skin reactions, particularly erythema, in estimates of approximate doses received is discussed. Classical biochemical examinations were of little value in establishing the degree of irradiation. (C.H.)

8649 TREATMENT OF VICTIMS OF THE ZERO-ENERGY REACTOR ACCIDENT AT VINČA. H. P. Jammet (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). p.83-103 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961.

The zero-energy reactor accident that occurred at Vinča, Yugoslavia, in Oct. 1958 resulted in the exposure of 6 persons to whole-body neutron and γ irradiation at doses estimated as ranging from 350 to 640 rad. The clinical picture, skin reactions, hematological findings, visceral and genital disturbances, biochemical findings, and treatment are described in detail. The most severely irradiated patient received a transfusion of foetal hematopoietic tissue and a transplantation of adult bone marrow, but the outcome was fatal. Four other patients also received transplantations of adult bone marrow, on the 27th to 36th day following exposure. All patients received symptomatic treatment as

dictated by clinical developments, special diets, and supportive therapy with vitamins, amino acids, and hormones. The clinical and hematological condition of the 5 surviving patients was satisfactory on Feb. 15, 1959. (C.H.)

8650 FOLLOW-UP STUDIES OF EXPOSED PERSONS IN THE ZERO-ENERGY REACTOR ACCIDENT AT VINČA. B. Radojičić (Military Academy of Medicine, Belgrade), S. Hajduković, and M. Antić. p.105-11 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961.

Data are summarized on results of clinical and laboratory findings over a two-year period on 5 patients injured in the zero-energy reactor accident at Vinca, Yugoslavia, in Oct. 1958. The general condition of the patients during convalescence was characterized by fatigability, decreased physical fitness, facial pallor, and slight asthenia. Although these symptoms gradually decreased in intensity, they still persisted two years after the accident. (C.H.)

8651 A RADIATION FATALITY RESULTING FROM MASSIVE OVEREXPOSURE TO NEUTRONS AND GAMMA RAYS. Thomas L. Shipman (Los Alamos Scientific Lab., N. Mex.). p.113-33 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961.

On Dec. 30, 1958, an accident occurred at the Los Alamos Scientific Laboratory that resulted in an estimated average whole-body neutron and γ ray dose of 3900 to 4900 rad, with incident dose of 12,000 rad to the upper abdomen and 10,400 rad incident dose to the head of an individual. Death from cardiac arrest occurred about 35 hrs after the accident. The circumstances leading to the accident are reviewed and dosimetry methods are discussed. The early symptoms, clinical course, biochemical findings, and pathology are described in detail. (C.H.)

8652 THE CLINICAL DIAGNOSIS OF ACUTE RADIATION SICKNESS. G. A. Zedgenidze (Inst. of Medical Radiology, Academy of Medical Sciences, Moscow). p.135-40 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961.

Observations are reported on the occurrence, symptoms, and radiographic findings during radiation sickness in more than 1000 cancer patients who received therapeutic doses of x radiation ranging from 6,000 to 30,000 r total dose. Radiation sickness occurred most frequently following irradiation of the organs of the abdominal cavity and was never seen after irradiation of the extremities. Individual constitutional factors governed the onset of symptoms, which were dominated by functional disturbances. Since such disturbances were often related to a preexisting condition or age of the patient, it was difficult to establish a direct relation to radiation effects. The abdominal and thoracic organs often exhibited severe functional disturbances but insignificant anatomical changes on histological examination. Results of clinical studies are summarized. (C.H.)

8653 DOSIMETRIC CONSIDERATIONS IN CRITICALITY EXPOSURES. J. A. Auxier (Oak Ridge National Lab., Tenn.). p.141-50 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961.

Radiation dose determinations for persons exposed to critical assemblies have been complex and difficult since the persons involved were inadequately monitored. Results are reported for detailed dosimetry studies made for the Oak Ridge Y-12 accident and the zero power reactor accident at Vinča, Yugoslavia. The activation of Na^{23} in the body of the victims to Na^{24} was used to determine neutron and γ doses. The quantity of neutron dose per unit sodium activation was determined by both theoretical and experimental methods. For the Y-12 accident, the γ/neutron dose ratio was determined as a function of distance from the reactor by proportional counters and ionization chambers with the assembly operated at a low power level. During a high-power operation, the neutron flux in several energy increments was measured with threshold detectors, and the Na activation as a function of neutron dose was determined for a live donkey. From these measurements, the total exposures were calculated. The doses corresponding to the Na^{24} activity in the individual were calculated from from first principles. Measurements of the γ/neutron dose ratio at the Vinča reactor were made with a proportional counter, a Radsan dosimeter, and a special Geiger counter detector with a low fast-neutron response and a thermal neutron shield. Compartmented shell phantoms containing aqueous NaCl solution were used to obtain the Na activation as a function of neutron dose. Data are tabulated on the radiation measurements and individual dose values for personnel exposed in the two accidents. (C.H.)

8654 ACUTE RADIATION EFFECTS ON MAN REVEALED BY UNEXPECTED EXPOSURES. Sven-åge Killmann, Eugene P. Cronkite, Victor P. Bond, and Theodor M. Fliedner (Brookhaven National Lab., Upton, N. Y.). p.151-64 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961. (BNL-5088)

Laboratory procedures that have been proposed as biological dosimeters of acute radiation injury are reviewed. Determinations of urinary β-aminoisobutyric acid excretion are considered potentially useful as a biological dosimeter of radiation injury, but much experimental work is needed on the constancy and dose-dependence of this test. The mitotic index of the bone marrow is helpful in evaluating the exposure of irradiated human beings but reliable determinations require experience on the part of the investigator. Other parameters that may eventually become of prognostic value are the number of circulating DNA-synthesizing cells in the blood and the DNA-synthesizing capacity of bone marrow cells. The most useful laboratory procedure for evaluating the status of irradiated individuals which has been developed to date is serial blood counts. They are indispensable in the clinical management of such cases and give some idea of later developments at a relatively early stage. The magnitude of the initial lymphocyte depression is an indication of the severity of exposure. The treatment of a patient with radioinduced haemopoietic syndrome presents the same problems as the management of any other patient with pancytopenia. However, in the irradiated patient the aplastic state of the bone marrow may be reversed, and if the patient can be carried through the critical period he will recover. Procedures are outlined for treatment of acute radiation injuries. (C.H.)

8655 SECONDARY SYNDROME: A STUMBLING BLOCK IN THE TREATMENT OF LEUKAEMIA BY WHOLE-BODY IRRADIATION AND TRANSFUSION OF ALLOGENIC HAEMOPOIETIC CELLS. Georges Mathé (Hopital Saint-Louis, Paris and Institut Gustave-Roussy, Villejuif, France). p.191-223 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961.

Results are reported for the treatment of leukemia in mice and in man by irradiation followed by transfusion of hemopoietic cells. It was concluded that man behaves similarly to other animals in regard to the transplantation of hemopoietic tissue. A graft is possible in both cases and there are identical complications due to the secondary syndrome. It is important to apply this treatment at a

phase in the disease when the number of leukemic cells is at a minimum, and it is necessary to make use of the immune reaction of the allogenic graft. There is reason to hope that progress will be made in our knowledge of leukemogenic antigens. So far, not a single patient or animal with leukemia has been cured. In every case the subject has died either from the disease itself or from the secondary syndrome. However, it is hoped that progress in radiobiology, advances in the chemoprophylaxis of radiation injury, the development of cancer antigens, and knowledge of infectious leukemogenic factors will result in the cure of leukemic patients. (C.H.)

8656 PROBLEMS IN THE PROCUREMENT, PRESERVATION AND ADMINISTRATION OF HUMAN BONE MARROW. L. M. Tocantins (Jefferson Medical Coll., Philadelphia). p.225-35 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961.

Techniques are described for the preparation and preservation of bone marrow for use in transfusions. Results are summarized for the treatment of acute leukemia with marrow from excised ribs. Results were not encouraging. The transplantation of human marrow from excised ribs to patients with aplastic and hypoplastic anemias gave more encouraging results, but no cures. One patient with a reticulum cell sarcoma, involving most of the peripheral nodes, mediastinal nodes, and spleen, recovered following massive suppressive therapy followed by injection of autologous bone marrow. The case history is reviewed. (C.H.)

8657 WHOLE-BODY IRRADIATION FOR RENAL HOMOTRANSPLANTATION. M. Tubiana, C. M. Lalanne, and J. Surmont (Institut Gustave-Roussy, Villejuif, France). p.237-63 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization. 1961.

During 1959 and 1960, 4 patients were given whole-body irradiation to lower the immunological defenses of the body and make it possible to attempt the transplantation of a kidney taken from another person. Observations are reported on the response of these patients to exposure to doses of 400 to 450 rad whole-body irradiation, followed in 2 to 4 months by a second exposure to 100 rad whole-body irradiation. The clinical course in the patients showed 4 distinct phases. Results of laboratory studies during each phase are included. The response to the second irradiation was severe in all cases. It was concluded that man can tolerate uniform whole-body exposure to doses of 400 to 450 rad, provided precautions are taken for the avoidance of infections. (C.H.)

8658 PROCUREMENT AND PRESERVATION OF HUMAN FOETAL TISSUES AND THEIR USE IN THE TREATMENT OF INJURY TO BLOOD-FORMING TISSUES. H. E. M. Kay (Royal Marsden Hospital, London). p.265-72 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961.

Procedures are described for the procurement and preservation of human foetal tissues for use in the treatment of injury to blood-forming tissues. The use of the tissues in the treatment of radiation injury, and for use in tissue culture and other research activities are discussed briefly. Factors affecting tolerance to foetal cells after injection into adults are considered. (C.H.)

8659 BONE MARROW TRANSPLANTATION IN MAN. E. Donnall Thomas (Mary Imogene Bassett Hospital, Cooperstown, N. Y.). p.273-88 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961.

Results are reviewed for 20 patients with leukemia treated by whole-body irradiation followed by infusions of bone marrow. Case histories are presented for 4 patients. It is concluded that whole-body irradiation is beneficial to some patients with leukemia, but that irradiation alone is not likely to cure leukemia. It was also concluded that man can withstand doses of radiation up to at least 1600 rad and avoid a fatal syndrome of the intestinal type. (C.H.)

8660 AUTOLOGOUS BONE MARROW IN THE TREATMENT OF SEVERE IATROGENIC MYELO-SUPPRESSION. N. B. Kurnick (Univ. of California, Los Angeles and Veterans Administration Hospital, Long Beach, Calif.). p.309-27 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961.

Results are reported on 17 patients treated with bone marrow infusions as a means of extending the range of radiotherapy and chemotherapy beyond the limits generally imposed by suppression of marrow function. A total of 77 collections of bone marrow was performed from 72 individuals. Of these, 73 were made to obtain marrow for storage by freezing and the other 4 for direct infusion into recipients without storage. Both isologous and homologous infusions were given. Procedures are described for the collection, storage, and re-infusion of marrow. Data are tabulated according to the disease treated, and clinical results are described. Evidence of successful bone marrow repopulation was seen in nearly every case. (C.H.)

8661 FATE OF SKIN GRAFTS IN IRRADIATED RABBITS TREATED WITH ALLOGENIC ADULT OR FOETAL HAEMOPOIETIC TISSUE. K. A. Porter (St. Mary's Hospital, London). p.329-37 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961.

Injection of 20-day fetal liver suspension into rabbits exposed to lethal doses of x rays was as successful in preventing early post-irradiation deaths as treatment with adult bone marrow, and fewer late deaths occurred following injection of fetal liver. Between the 13th and 25th week after irradiation, the hemopoietic and lymphoid tissues of the established fetal-liver chimeras reverted spontaneously from donor type to host type. This reversion was usually accompanied by loss of weight and anemia, and occasionally led to death of the animal from infection. Skin homografts usually persisted for considerably longer on radiation-induced rabbit chimeras than on normal unirradiated rabbits. This survival was longer when the skin grafts came from the donor of the bone marrow, or when fetal hemopoietic tissue was used in creating the chimera. Heterografts from mice and guinea pigs never survived for more than a very short time on radiation-induced rabbit chimeras. It is tentatively suggested that although all radiation-induced rabbit chimeras show an impairment of the mechanisms by which foreign antigens are reacted to, rabbits treated with fetal liver exhibit in addition something resembling an actively acquired tolerance. (C.H.)

8662 PHARMACOLOGICAL CHARACTERISTICS OF CERTAIN MERCAPTOAMINES AND THEIR EFFECTIVENESS IN THE PROPHYLAXIS OF RADIATION SICKNESS. A. M. Rusanov (Central Inst. for Scientific Research in Medical Radiology, Ministry of Health, Leningrad). p.347-59 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961.

The pharmacological action and protective effects against radiation injury of cysteamine, mercaptopropylamine (MPA), and aminoethylisothiouronium (AET) were studied by a number of different techniques in frogs, white mice,

white rats, rabbits, and cats. The methods included observation of irradiated animals, plotting of individual tolerance curves, recording the activity of various organ systems and isolated organs, histoautoradiography, and determination of mitotic activity and regeneration of the corneal epithelium. The results show that these compounds vary in toxicity and in their protective effects. The administration of cysteamine and MPA in the optimum protective doses caused convulsions and sometimes death. AET had the widest range of therapeutic action and was the least toxic of the compounds tested. It was concluded that the mechanism of the protective action of AET is dependent not only on the ability of AET to modify physiochemical processes but also on its effects on the physiology and biochemistry of the body. (C.H.)

8663 TREATMENT OF IRRADIATED MONKEYS WITH AUTOLOGOUS AND HOMOLOGOUS BONE MARROW. D. W. van Bekkum (Organization for Health Research TNO, Rijswijk, Netherlands), L. M. van Putten, M. J. de Vries, and B. G. Crouch. p.361-2 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961.

Macaca mulatta monkeys were exposed to whole-body x irradiation and treated with fresh bone marrow cell suspensions. The animals were also treated with antibiotics after irradiation. Frequent hematological examinations were made in all cases and complete autopsies, including microscopical examination of the tissues, were performed on the monkeys that died spontaneously. Animals that received autologous bone marrow injections after irradiation lived more than 50 days while animals that received homologous bone marrow lived less than 50 days. Results indicate that secondary disease in the primate radiation chimera is more severe than in irradiated mice treated with foreign bone marrow. (C.H.)

8664 EXPERIMENTAL TREATMENT OF RADIATION INJURY IN MONKEYS. D. R. Anderson (School of Aviation Medicine, Brooks AFB, Tex.). p.363-84 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961.

Results are reported from comparative studies in four groups of monkeys exposed to an air dose of 900 r x radiation. One group served as an irradiated control group, one group was given chemical protection with AET and cysteine before irradiation, one group was given bone marrow after irradiation, and one group was given chemical treatment before irradiation and bone marrow treatment afterwards. Data are tabulated. Results indicate that those animals receiving marrow only and those receiving combined treatment with AET-cysteine and marrow showed a similar response. (C.H.)

8665 EFFECTS OF WHOLE-BODY IRRADIATION IN MAN AND THEIR MODIFICATION BY EXPERIMENTAL AND THERAPEUTIC MEANS. J. F. Loutit (Medical Research Council, Harwell, Berks, Eng.). p.393-402 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961.

Problems involved in the protection of man against the hazards of radiation accidents are reviewed. The function of the health physicist in the design, testing, and operation of critical assemblies is discussed. Methods for the modification, diagnosis, and treatment of radiation casualties are discussed. The need is emphasized for hospitals to maintain sterile suites where victims of radiation accidents, as well as thermal burn patients, could be cared for adequately. (C.H.)

CHEMISTRY

General and Miscellaneous

8666 (IDO-14567) CHEMICAL PROCESSING TECHNOLOGY QUARTERLY PROGRESS REPORT, APRIL–JUNE 1961. J. R. Bower, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Nov. 10, 1961. Contract AT(10-1)-205. 72p.

The Idaho Chemical Processing Plant did not operate on fuel recovery during this period, due to extensive renovation and modification of facilities. Potassium fluoride was found to be an undesirable additive to the barium precipitating agent used in formation of barium fluozirconate, because of precipitation and loss of uranium, although essentially complete precipitation of zirconium was achieved. Addition of hydrofluoric acid with barium precipitant, to achieve a fluoride/zirconium mole ratio of 5.5, was found to give a total zirconium recovery of 95%, including approximately 10% recovered after concentration of the supernate from the original precipitation. Removal of 97% of the zirconium and fluoride from zirconium–uranium dissolver solutions was achieved by precipitation with two moles of sodium formate per mole of zirconium. Uranium was readily recovered from the concentrated filtrate and wash solution by TBP extraction. The preparation and characterization of zirconium nitrate dibutylphosphate are described, and the solubility in Amsco was found to be similar to that of the uranium dibutylphosphate complex (2 to 4×10^{-5} M). Stability studies indicated very little, if any, oxidation of ferrous to ferric iron in a normal raffinate environment, and ferrous iron has a very low molar extinction coefficient (0.8) compared with that of uranium (15) in the spectral region near 415 mμ. Pilot plant studies of the fluidized-bed calcination process for reduction of radioactive liquid wastes to the more-easily-stored solid form was continued in the two-foot-square calciner with production, for the first time over a prolonged period of continuous operation, of alpha alumina-free product from a feed containing substantial sodium. Intra-particle porosities ranging from 0.04 to 0.60 were obtained. Differences in alpha-forming tendency of amorphous aluminas with varied calcination histories were demonstrated but attempts at correlation with known variables in fluid bed calciner operation were not successful. Rapid (< 5 minutes) precipitation of zirconium, fluoride, and aluminum was achieved by addition of calcium oxide (CaO/F ratio = 1.5) as a slurry at 60°C. The second and third runs in the Demonstrational Waste Calcining Facility were conducted. Additional studies on removal of long-lived radioisotopes from waste solutions indicated that strontium can be removed from relatively acidic solutions (up to 1M) by absorption on Amberlite 200 cation exchange resin. A study of the anodic potential-current density relationships during the electrolytic dissolution of type 304 stainless steel, undertaken to define optimum operating conditions, revealed that at a temperature of 60°C or higher, anode operation was practical over a wide range of solution compositions (1 to 10M acid) and high current densities (up to 2 amp/cm^2), since passivation, limiting current density, and gas evolution were avoided. A new technique in electrolytic dissolution was demonstrated. The metal to be dissolved is placed in a tubular dissolver through which an acid dissolving solution is passed; electrodes, not in direct contact with the metal but immersed in the electrolyte, are located at the ends of the dissolver. A series of electrolytic cells is formed within the dissolver. Dissolution rates of 2.5 mg/cm^2/min at current efficiencies of 1000% were demonstrated for stainless steel. Titanium and niobium test coupons were resistant to corrosion in locations in an operating electrolytic dissolver where stainless-steel specimens were rapidly destroyed. Plastic specimens, which had previously been shown to be resistant to the chemical environment in an electrolytic dissolver, were exposed to gamma irradiation (up to 10^9 R) while exposed to the dissolver solution; only polyethylene, in this group, adequately resisted the combined radiation and chemical conditions to warrant further testing as a possible insulating and supporting material for dissolver construction. Application of the ARCO Process to niobium appeared feasible, the dissolution rate being readily controlled by chlorine rate and at least 99.9% of the dissolved niobium being sublimed from the melt as niobium pentachloride. Chloride was readily removed, by refluxing, from 8M or stronger nitric acid leach solution used to extract uranium from the lead chloride matrix resulting from the ARCO Process, thus giving a solvent extraction feed solution compatible with stainless-steel equipment. Chloride vapor-liquid distribution coefficients are presented. Corrosion tests indicated the possible usefulness of Haynes 21 or Haynes 25 alloys for structural use in an ARCO Process dissolver system; corrosion rates experienced were 2 to 3 mils/month in a lead-lead chloride-chlorine system at 520°C. Analog simulation of the 1A column air pulser to determine theoretical operating curves showed a square wave to be a satisfactory representation of the pressure input, and an average value of the friction factor to be an excellent substitute for a variable factor. A maximum change in orifice coefficient expected for flow through the column plates, or a 10% change in organic holdup in the column, changed the pulse amplitude less than 10% in the normal operating range. A cascade control system was specified for the new first cycle product evaporator to provide rapid response to feed rate changes and to better maintain product quality. A systems study of pulsed extraction columns was initiated. Equations representing a five-stage simplified model for the nearly ideal system, water–acetic acid-hexone, were solved in the analog computer to determine the effect of composition and flow disturbances at constant holdup. At aqueous and organic flow rates of 200 gal/hr-ft^2, a sudden composition disturbance in the aqueous feed gave time constants ranging from 19 to 113 sec from top to bottom of the column. A 100% disturbance in aqueous flow gave time constants from 19 to 26 sec. Gaseous ozone-oxygen dissolved in water (0.27 mg O_3/100 ml water) was found to be a suitable decontaminant for removing Ag^{110} from samples of aluminum and stainless steel taken from the ETR circulating water loop, achieving a decontamination factor of 50 or greater. Partial molal volumes calculated from previously presented density data for some Zirflex-type solutions are given. (auth)

8667 (NYO-9862) SYNTHESIS OF SEMICONDUCTOR MATERIALS BY RADIATION INDUCED REACTIONS. Quarterly Status Report No. 10, August 1 to October 31, 1961. Kalman Held and Richard J. Goldman (TRG, Inc., Syosset, N. Y.). Contract AT(30-1)-2392. 12p. (TRG-132-QTR-10)

Progress is reported on work done in electric discharge experiments with silane, studies of homogeneous and heterogeneous chain reactions, construction of continuous

flow systems for the decomposition of silane, the preparation of silane, and continuous flow decomposition experiments on silane. (B.O.G.)

8668 (AWRE/Trans/26) STUDIES OF CALCIUM AND STRONTIUM COMPLEXES WITH CERTAIN ALIPHATIC POLYCARBOXYLIC ACIDS. Z. Tamura and Y. Matsushima. Translated by F. E. Waliwork (U.K.A.E.A. Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.) from Yakugaku Zasshi, 79: 1526-8(1959). 8p.

A study was conducted to determine the properties of tricarballylic acid, 1,1,2,3-propanetetracarboxylic acid, and meso-1,2,3,4-butanetetracarboxylic acid for forming complexes with Ca^{45} and Sr^{90} at pH values from 6.2 to 7.3. Tabulations are included of the stability constants of the complexes and an example of the analysis of the experimental data. (B.O.G.)

8669 GROWTH-REGULATING PROPERTIES OF DEUTERATED 2,4-DICHLOROPHENOXYACETIC ACID. Margaret S. Smith (Wye Coll., nr. Ashford, Kent, Eng.). J. Sci. Food Agr., 13: 48-52(Jan. 1962).

The preparation of side-chain deuterated 2,4-dichlorophenoxyacetic acid (2,4-D) is described. The growth-regulating properties of the product, examined by three methods, were similar to those of 2,4-D. (auth)

Analytical Procedures

8670 (AE-60) DETERMINATION OF ELEMENTS IN NORMAL AND LEUKEMIC HUMAN WHOLE BLOOD BY NEUTRON ACTIVATION ANALYSIS. D. Brune, B. Frykberg, K. Samsahl, and P. O. Wester (Aktiebolaget Atomenergi, Stockholm). Nov. 1961. 16p.

No significant differences were observed between the concentrations of elements in normal and leukemic human whole blood examined by gamma spectrochemical methods after reactor activation. Data are presented on the concentrations of Mn, Cu, Zn, Na, P, Sr, Fe, Ca, Au, Sb, Cd, Cs, and Rb in blood. (C.H.)

8671 (AE-61) COMPARATIVE AND ABSOLUTE MEASUREMENTS OF 11 INORGANIC CONSTITUENTS OF 38 HUMAN TOOTH SAMPLES WITH GAMMA-RAY SPECTROMETRY. K. Samsahl (Aktiebolaget Atomenergi, Stockholm) and R. Soeremark (Sweden. Tandläkarhögskolan, Stockholm). Dec. 1961. 22p.

The mean concentrations of eleven elements (Na, P, Cl, Ca, Mn, Cu, Zn, Br, Sr, W, and Au) in normal human dentine, enamel, and dental calculus are determined by gamma spectrometry. Samples are irradiated typically in thermal neutron fluxes of about 1.5×10^{17} neutrons/cm^2 prior to analysis. Qualitative determinations are also made for the long-lived elements Cr, Fe, Co, Rb, Ag, Sb, Cs, and Ba. (auth)

8672 (AERE-R-3875) THE SPECTROGRAPHIC DETERMINATION OF SOME NON-METALLIC ELEMENTS IN SOLUTION BY THE COPPER-SPARK METHOD. William H. Taylor and M. S. W. Webb (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). Oct. 1961. 14p.

The copper-spark method is applied to the determination of some of the nonmetallic elements in solution. Permissible concentration ranges are: selenium, 3000 to 5 ppm; bromine and iodine, 3000 to 10 ppm; chlorine, 1000 to 10 ppm; sulfur, 100 to 10 ppm; and fluorine, 1000 to 100 ppm. The coefficient of variation for single determinations is 10 to 30%. (auth)

8673 (CNEN-97) DETERMINAZIONE SPETTROFOTOMETRICA DEL SILICIO IN COMPOSTI DI URANIO. (Spectrophotometric Determination of Silicon in Uranium Compounds). W. Barbieri, L. Lorenzini, and C. Stoppa (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Nov. 1961. 12p.

On the basis of the colorimetric determination of silicon by the yellow silicomolybdic acid formation or by its reduction to molybdenum blue, three methods for the determination of the silicon in uranium are proposed. Silicon was determined on the solution employing the above methods after extraction of the uranyl nitrate by TBP. Finally a direct uranium determination was carried out using ammonium molybdate, dissolving the precipitated uranyl molybdate with tartaric acid, and reducing the molybdate to molybdenum blue. (auth)

8674 (IDO-14576) DETERMINATION OF HEAVY WATER PURITY BY INFRARED ABSORPTION. R. M. Abernathey and T. D. Morgan (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Jan. 16, 1962. Contract AT(10-1)-205. 7p.

The practical application of heavy water purity determination by infrared absorption spectroscopy using standard laboratory equipment was demonstrated in connection with the operation of heavy water-moderated Special Power Excursion Reactor Test (SPERT II) Facility at the NRTS. (auth)

8675 (KAPL-M-AHA-2) DETERMINING HYDROGEN CONCENTRATIONS IN 1 WT % URANIUM–ZIRCONIUM ALLOY AND ZIRCALOY-2 BY UTILIZING THE EQUILIBRIUM GAS PRESSURE. A. H. Alberts (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 3, 1961. Contract W-31-109-eng-52. 10p.

A method for measuring H concentration in Zr and Zr alloys is examined. The H equilibrium pressure over single-phase metallic materials is a function of concentration at any specified temperature. A comparison of this method with the vacuum fusion and hot extraction methods is presented and recommendations for further development are made. (J.R.D.)

8676 (KAPL-M-FW-4) THE DETERMINATION OF HAFNIUM IN Ze-4 AND Ze-6 ZIRCONIUM METAL STANDARDS BY THE STABLE ISOTOPE DILUTION AND NEUTRON ACTIVATION METHODS. F. W. Walker (Knolls Atomic Power Lab., Schenectady, N. Y.). Dec. 21, 1961. Contract W-31-109-Eng-52. 26p.

Two methods are described for the determination of hafnium in zirconium metal standards, namely stable isotope dilution analysis and neutron activation analysis. Hafnium values obtained for ZE-4 and ZE-6 standards are 77.4 ± 3.9 (tentative value) and 166 ± 17 ppm, respectively, by the stable isotope dilution technique, and 77.5 ± 8 and 155 ± 16 ppm, respectively, by the neutron activation technique. (auth)

8677 (ORNL-3243) ANALYTICAL CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1961. (Oak Ridge National Lab., Tenn.). Feb. 9, 1962. Contract W-7405-Eng-26. 134p.

Research and development progress is reported on analytical instrumentation, dissolver-solution analyses, special research problems, reactor projects analyses, x-ray and spectrochemical analyses, mass spectrometry, optical and electron microscopy, radiochemical analyses, nuclear analyses, inorganic preparations, organic preparations, ionic analyses, infrared spectral studies, anodization of sector coils for the Analog II Cyclotron, quality control,

process analyses, and the Thermal Breeder Reactor Projects Analytical Chemistry Laboratory. (M.C.G.)

8678 (ORNL-TM-113) CONTROLLED-POTENTIAL COULOMETRIC TITRATION OF URANIUM(VI) IN THE PRESENCE OF NITRATE. W. D. Shults (Oak Ridge National Lab., Tenn.). Jan. 17, 1962. Contract [W-7405-Eng-26]. 10p.

A study into the use of sulfamic acid as a nitrite-destroying reagent in the controlled-potential coulometric titration method for uranium(VI) was made. When nitrites are thus destroyed, the titration is much less subject to error from HNO_3. The results of titrations of known amounts of uranium(VI) in the presence of various amounts of HNO_3, $Th(NO_3)_4$, $Al(NO_3)_4$, and $LiNO_3$ are given. (auth)

8679 (PG-Report-212) ANALYTICAL METHOD FOR THE DETERMINATION OF FLUORIDE IN PURE URANYL NITRATE LIQUORS. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1961. 8p.

The liquor is steam-distilled in the presence of sulfuric acid at 150°C. The distillate is titrated with thorium nitrate solution using chrome azurol S as an indicator. The method is applicable for fluoride concentrations of 0.5 to 10 μg/ml. At 1 μg/ml the precision (3 × sigma) is ±30% relative. (auth)

8680 (PG-Report-226) ANALYTICAL METHOD FOR THE DETERMINATION OF NITRATE IN URANIUM TRIOXIDE. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1961. 8p.

The sample is dissolved in dilute sulfuric acid and the nitrate is reduced using Devarda's alloy in alkaline solution. The ammonia is determined volumetrically after steam distillation. The method is suitable for the determination of amounts of nitrate up to 0.6%. Larger amounts may be determined by increasing the volume of standard acid in the distillate receiver, or by taking a smaller portion of sample. The accuracy of the method is considered to be without bias. At the 0.4% level the precision (3 × sigma) is ±5% relative. (auth)

8681 (PG-Report-262) ANALYTICAL METHOD FOR THE DETERMINATION OF INORGANIC AND TOTAL PHOSPHORUS IN URANYL NITRATE SOLUTIONS AND AMMONIUM DIURANATE. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1962. 8p.

The applicability of the determination methods were as follows: for inorganic phosphorus, within the range 1 to 15 ppm for ammonium diuranate and 1 to 15 μg/ml for uranyl nitrate solutions based on samples containing 1 gm of uranium; and for total phosphorus, in the range of 2 to 30 μg/ml for uranyl nitrate and 2 to 30 ppm on as received samples of ammonium diuranate. No systematic bias was detected in the accuracy. The precision for the inorganic phosphorus determinations at the 12 μg level is ±10% relative. (auth)

8682 (TID-11411) THE DETERMINATION OF NITROGEN IN ZIRCALOY AND OTHER ALLOYS. A SIMPLIFIED DISTILLATION APPARATUS. J. R. Ciaranello (Knolls Atomic Power Lab., Schenectady, N. Y.). [nd.] Contract W-31-109-eng-52. 9p.

A modified apparatus for the Kjeldahl determination of nitrogen in zircaloy and other alloys is presented. To prevent bumping of the alkaline slurry, compressed air, or other gas from line or cylinder is used instead of steam during the distillation process. The resulting apparatus is simpler, more compact, and more easily maintained. The apparatus was used in the analysis of zircaloy, niobium, steel, inconel, and other alloys. (auth)

8683 (TID-14741) A SIMPLIFIED AUTOMATIC PHOTOMETRIC TITRATOR APPLIED TO THE TITRATION OF MICROGRAM AMOUNTS OF SULFATE. William G. Ellis and Ernest A. Brown (National Lead Co. of Ohio, Cincinnati). [1961?]. Contract [AT(30-1)-1156]. 17p.

A versatile photometric titrator was developed based upon modifications to a Beckman Model B spectrophotometer. The cell compartment was modified to accommodate a simplified titration assembly consisting of a motor-driven stirrer, a reagent reservoir, and a syringe buret. A compact, gear-driven buret mechanism is used to deliver the titrant to the cell at a controlled rate. An automatic start-stop electrical circuit is employed in the buret and recorder chart drive for convenience of operation. In order to record light transmission values as linear displacements on the strip chart, a line-operated attenuator circuit is used. The end point is detected from the inflection point on the strip chart recording. The automatic photometric titrator was applied to the volumetric titration of sulfate with barium perchlorate using thorin as an indicator. Well defined end points were found with 50 to 200 micrograms of sulfate in the titration cell. The photometric titrator was found to overcome the limitations of methods employing visual end points thereby making possible the use of the volumetric method in the microgram concentration level. (auth)

8684 (AERE-Trans-881) DETERMINATION OF STRONTIUM-90 IN WATER-SAMPLES BY ION-EXCHANGE PROCESSES. H. Knapstein. Translated by J. H. Waton (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Z. anal. Chem., 175: 255-65 (1960). 17p.

The problems of the determination of Sr^{90} in water samples are summarized. An ion-exchange method is described, which depends on the adsorption of all the cations on the resin and selective elution of the alkaline-earth metals with ammonium lactate. A procedure is given for drinking, surface, and tank water, which enables Sr^{90} to be determined with great accuracy. Results of some investigations of drinking and tank water from Schleswig-Holstein are presented. (auth)

8685 (AWRE/TRANS/25) QUANTITATIVE DETERMINATION OF BERYLLIUM BY MEANS OF ARSONIC ACID. A. I. Portnov, V. A. Grizo, and A. I. Zakin. Translated by F. E. Wallwork (U.K.A.E.A. Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.) from Zavodskaya Lab., 19: 660-1(1953). 6p.

Beryllium can be quantitatively determined in, and separated from, Ca, Mg, Sr, and Ba by precipitation of the Be with monosodium salts of arsanilic, parahydroxyphenylarsonic, or parahydroxymetanitrophenylarsonic acid. The method is applicable for Be concentrations of about 10 to 100%. A similar method is described for Be separation from Al, in the Be concentration range around 50%. (T.F.H.)

8686 (CEA-tr-X-315) DETERMINATION DU TRITIUM PAR DES MESURES DE RADIOACTIVITE A HAUTE PRECISION DANS UN COMPTEUR G.M. (Determination of Tritium by Measuring the Radioactivity at High Precision in a G-M Counter). V. Santoro. Translated into French from Gazz. chim. ital., 89: 2102-10(1959). 27p. (Includes original, 10p.).

An apparatus and method are described for measuring the radioactivity from tritium utilizing a G-M counter into which the tritium is admitted. The method has a precision greater than 0.5%. A description and interpretation of the characteristic curves of the counter is presented, assuming that tritium is the source of the radiation. (tr-auth)

8687 (UCRL-Trans-766(L)) SPECTRAL ANALYSIS BY THE VAPORIZATION METHOD. V. ANALYSIS OF PLUTONIUM BY THE VAPORIZATION METHOD IN VACUUM. A. N. Zaidel', N. I. Kaliteevskii, L. V. Lipis, and V. M. Tarakanov. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Optika i Spektroskopiya, 3: 16-20(1957). 10p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract no. 9711.

8688 THE ANALYTICAL CHEMISTRY OF NIOBIUM AND TANTALUM. W. T. Elwell and D. F. Wood (Imperial Chemical Industries, Ltd., Birmingham, Eng.). Anal. Chim. Acta, 26: 1-31(Jan. 1962). (In English)

Discussion is given on the general chemistry, decomposition procedures, separations, hydrolytic precipitation, precipitating reagents, chlorination precedures, solvent extraction procedures, and methods of determination, such as gravimetric, volumetric, colorimetric, and polarographic. A brief description is also given of the history and the uses of the two metals. 269 references are included. (P.C.H.)

8689 RADIOMETRIC TRACE ANALYSIS OF LEAD WITH DIETHYLDITHIOCARBAMATE AND ^{204}Tl. P. C. van Erkelens (Inst. for Animal Husbandry "Schoonoord," Utrecht). Anal. Chim. Acta, 26: 32-45(Jan. 1962). (In English)

Two methods for the determination of submicrogram amounts of lead are described. Lead is selectively extracted with carbon tetrachloride from an alkaline solution containing excess diethyldithiocarbamate (DDC) and cyanide. Traces of DDC are back-extracted. The lead in the DDC complex is exchanged with Tl^{204} and the amount of Tl^{204} in the organic layer acts as a measure for the lead. The limit of sensitivity is 0.1 μg; the standard deviation is 11% (for 0.1 μg). Bismuth and thallium interfere; their influence can be accounted for with the help of EDTA, however. In the second method excess cyanide is added to the alkaline sample solution and lead is exchanged selectively with Tl^{204} by shaking with a $CHCl_3$ solution containing $Tl^{204}(DDC)_1$. As the process is not 100% effective (with a reasonable excess of the thallium complex) isotope dilution with Pb^{210} is also carried out. The amount of Tl^{204} in the aqueous layer acts as a measure for the exchanged lead. The limit of sensitivity is 0.05 μg and the standard deviation is 12% (for 0.05 μg). Bismuth and thallium must be removed in advance by anion exchange. (auth)

8690 RADIOMETRIC TRACE ANALYSIS OF COBALT WITH DIETHYLDITHIOCARBAMATE-^{35}S, OR ^{203}Hg. P. C. van Erkelens (Inst. of Animal Husbandry "Schoonoord," Utrecht). Anal. Chim. Acta, 26: 46-57(Jan. 1962). (In English)

Two radiometric methods for the determination of submicrogram amounts of cobalt are described. Cobalt is extracted from an ammoniacal solution with a zinc–diethyldithiocarbamate–S^{35} solution in chloroform. Excess reagent and interfering metals are removed with mercury(II) and cyanide. The S^{35} in the final organic layer is a measure of the cobalt in this layer. In the second method cobalt is extracted from an ammoniacal solution with a fixed amount of zinc–DDC in chloroform. Excess reagent and complexes of foreign metals are removed by exchange with $Hg^{203\ 2+}$ and the Hg^{203} in the chloroform (compared with a blank) acts as a measure of the cobalt. The first method is applicable to 0.1 μg of cobalt and the second to 0.8 μg. As the efficiency of both processes is variable, isotope dilution with Co^{60} is carried out. A 10-fold and 4-fold excess of foreign metals is permitted in the first and second method, respectively; larger amounts are previously removed by extraction with inactive zinc–DDC from sodium hydroxide media. (auth)

8691 STABLE PLASMA JET FOR EXCITATION OF SOLUTIONS. Louis E. Owen (Goodyear Atomic Corp., Portsmouth, Ohio). Appl. Spectroscopy, 15: 150-2(1961). (GAT-T-823)

A plasma jet, as adapted for the spectrochemical excitation of solutions and used with a photoelectric spectrometer to measure light intensities, is described. Included is the design, construction, part specifications, operation, and performance of the stable plasma jet. The jet has a tungsten rod as an external, yet integral, cathodic electrode. The stabilized jet promises full utilization of the jet's special feature of high temperature excitation of homogeneous samples which can be reproducibly introduced into its excitation zone. With the stabilized jet the limiting factor seems to be the constancy of atomization. With reliable atomization, coefficients of variations of 0.5% or less should be achieved with good reliability. (N.W.R.)

8692 NEUTRON RADIOACTIVATION HELPS SOLVE CRIMES. R. E. Jervis (Univ. of Toronto). Can. Nuclear Technol., 21-4(Winter 1962).

A neutron activation analysis method is described for tracing the origin of hair. This method is to be used in solving crimes and shows promise of being as accurate as present fingerprint techniques used in forensic science. (N.W.R.)

8693 THE USE OF γ-QUANTA BY THE REACTION OF α-PARTICLES WITH FLUORINE AND BORON NUCLEI IN ESTIMATING THESE ELEMENTS IN ORE CONCENTRATES. I. N. Plaksin, M. A. Belyakov, and L. P. Starchik (Inst. of Mining, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 141: 921-4(Dec. 1, 1961). (In Russian)

The content of various elements in ores and concentrates can be determined by selectively counting the gamma activity induced by alpha irradiation. The method is selective and rapid. Thus, in determining the content of fluorite (CaF_2) in $Na[AlSi_3O_8]$ (feldspar), the 1.24-Mev γ-quanta of Ne^{22}, resulting from the reaction $F^{19}(\alpha,p)Ne^{22}$, is selectively counted to give the fluorite content. The content of fluorite in beryllium concentrates can be similarly determined by counting the 1.24-Mev γ-quanta and the gammas having an energy >3.4 Mev, and then applying a correction. Boron was determined in the presence of ascharite ($MgHBO_3$) and dolomite by counting the 2.3- and 3.8-Mev gammas from N^{13} and C^{13} which are products of the reactions $B^{10}(\alpha,n)N^{13}$ and $B^{10}(\alpha,p)C^{13}$. All γ-quanta having energies of <2 Mev were discriminated against. This method can also be used to determine the content of fluorine and boron in solutions and alloys. (TTT)

8694 THE APPLICATION OF A (γ,n) NUCLEAR REACTION IN DETERMINING THE CONTENT OF BERYLLIUM IN SOLUTION AND AS A SUSPENDED SOLID. I. N. Plaksin, M. A. Belyakov, N. G. Malysheva, and L. P. Starchik. Doklady Akad. Nauk S.S.S.R., 141: 1158-60 (Dec. 11, 1961). (In Russian)

A (γ,n) reaction on beryllium is very selective because of the low excitation threshold of 1.63 Mev. Only deuterium

has an excitation threshold of 2.2 Mev which is close to that of the (γ,n) reaction on Be. A gamma source of Sb^{124} (1 mc) is used to irradiate a 400-cm^3 cuvet containing solution or pulped ore. The 25-kev neutrons coming from the (γ,n) reaction on Be are slowed down in paraffin and counted on a neutron counter. A linear relationship is obtained between the neutron count rate and the concentration of Be in solution (10 to 100 g/l of Be in $BeSO_4$ solution). The neutron count rate falls off sharply with >30 g/l of lithium in solution. The error due to neutron absorption by elements having a high capture cross-section can be reduced by decreasing the volume of irradiated solution and increasing the activity of the gamma source. The method was used to determine the content of beryllium in a mixture of beryl ($3BeO \cdot Al_2O_3 \cdot 6SiO_2$) and feldspar ($KAlSi_3O_8$). The method can be adapted for the automatic control of the Be content in pulped ores. (TTT)

8695 THE USE OF PAPER TREATED WITH TRI-n-OCTYLPHOSPHINE OXIDE FOR THE CHROMATOGRAPHIC SEPARATION OF METAL IONS. E. Cerrai and C. Testa (C.I.S.E., Milan). J. Chromatog., 7: 112-19(Jan. 1962). (In English)

A systematic study of chromatography with paper treated with 0.025 M tri-n-octylphosphine oxide (TOPO) in cyclohexane is described. Curves of the R_f values as functions of the acidity of the eluent are given for about fifty metal ions. The acids used were HCl, HNO_3, and H_2SO_4. Some parameters, such as temperature, imbibition time of the paper, elution time, and molarity of the TOPO solution were considered. Examples of separations of two or more elements are given to show the practical application of the proposed chromatographic technique. Generally, the higher the extraction coefficient E_a^0 of TOPO for a given element at the selected acidity, the lower the R_f value. The possibility of treating chromatographic cellulose powder with TOPO to obtain column separation of appreciable quantities of substances is suggested. (auth)

8696 THE USE OF THIOCYANIC ACID IN PAPER PARTITION CHROMATOGRAPHY. PART II. THIOCYANIC ACID AND ORGANIC BASES USED IN CONJUNCTION AS CHROMATOGRAPHIC SOLVENTS. L. C. Lock and E. C. Martin (Univ. of New South Wales, Kensington, Australia). J. Chromatog., 7: 120-7(Jan. 1962). (In English)

The chromatographic properties of eight solvents were determined. The solvents were n-butanol–water–perchloric acid which was non-complexing, and seven complexing solvents based on n-butanol–water–thiocyanic acid. The addition of one or the other of pyridine, aniline, or quinoline to the thiocyanic acid solution resulted in solvents which were buffered in the pH range 3 to 8. An analysis of variance carried out on the results enabled criteria of complexing properties to be established. It was found that these properties for the 38 ions tested were related to their electronic structure. (auth)

8697 FLUOROMETRIC DETERMINATION OF ZIRCONIUM IN THE PRESENCE OF TITANIUM BY QUERCETIN. A. P. Golovina, I. P. Alimarin, and L. A. Tenyakova. Vestnik Moskov. Univ., Ser. II, No. 3, 60-2(1961).

A fluorometric-chromatographic method for determining zirconium in the presence of titanium by quercetin is described. A zirconium quercetinate solution gives a strong orange-yellow fluorescence on exposure to ultraviolet light which masks any fluorescence due to titanium quercetinate, so it was essential to use both chromatographic and fluorometric techniques in order to obtain the desired result. The first step consisted of the development of a chromatographic procedure: the pipetting of aliquots of zirconium solution onto Whatman No. 1 paper, followed by the spraying of the spots with a quercetin-ethyl alcohol solution and then by their drying and subsequent identification under a Pk-2 ultraviolet lamp. Next, a study was made of the behavior of Zr, Ti, Th, Fe^{3+}, Al, and Be on paper with various solvents (mixtures of hydrochloric acid and ethyl alcohol, isopropyl alcohol and methyl-ethyl-ketone) the resulting chromatograms were examined afterwards in visible and ultraviolet light. The data showed that it was possible to differentiate between Zr, Ti, Fe, and Be on one chromatogram, and, therefore, to determine zirconium in the presence of titanium and iron; a 4:1 mixture of ethyl alcohol and hydrochloric acid was the most suitable solvent. In the last stage this solvent is used to effect a preliminary 8-hour separation of the above elements on chromatographic paper. After spraying with 0.01% quercetin solution, the intensities of fluorescence of the spots under ultraviolet light were compared with those of standards containing known amounts of zirconium (0.12-15 γ); the experimental error was ±0.2-0.4 γ. It was concluded that this method gives completely reliable results. (OTS)

8698 TEMPERATURE-FLOAT METHOD FOR ISOTOPIC ANALYSIS OF HEAVY WATER WITHIN LOW CONCENTRATION RANGES. E. Weingaertner, R. L. Datta, R. Kumar, and E. G. Mahadevan. p.170-80 of "Indian Institute of Science Golden Jubilee Research Volume, 1909-1959." Bangalore, India, Indian Institute of Science, 1959. (In English)

The method employs the measurement of temperatures at which samples of different D_2O concentration have the same density. Use is made of a quartz float, the density of which does not show appreciable variation with temperature within a range of ±3°C. A highly simplified apparatus is successfully employed for conducting the experiments. The equilibration temperature (i.e., the temperature at which the density of water is equal to that of the quartz float) for different samples of water of known D_2O concentration are determined, and a calibration curve plotted. This curve is used for assessing the concentration of an unknown sample. The results, when compared with those of the mass-spectrometer, show fairly good agreement. (auth)

8699 ANALITICHESKAYA KHIMIYA TALLIYA. (Analytical Chemistry of Thallium). I. M. Korenman. Moscow, Publishing House of the Academy of Sciences, 1960. 172p.

Systematic data are given on thallium reactions and methods for qualitative and quantitative determination. The applications of thallium in industry are also discussed. 923 references are included. (R.V.J.)

8700 TREATISE ON ANALYTICAL CHEMISTRY. PART II. ANALYTICAL CHEMISTRY OF THE ELEMENTS. VOLUME 5. N · P · Th · Ti · Zr–Hf. I. M. Kolthoff and Philip J. Elving, eds. New York, Interscience Publishers, 1961. 426p.

Nitrogen, phosphorus, thorium, titanium, zirconium, and hafnium are chemically analyzed. The analysis discusses the occurrence, industrial processes, toxicology and industrial hygiene, properties, sampling methods, separation and isolation methods, detection and identification methods, determination methods, compounds, and laboratory procedures of the elements. Separate abstracts have been prepared for the sections on hafnium and zirconium, thorium, and phosphorus. (N.W.R.)

8701 ZIRCONIUM AND HAFNIUM. Richard B. Hahn (Wayne State Univ., Detroit). p.61-138 of "Treatise on

Analytical Chemistry. Part II. Analytical Chemistry of the Elements. Volume II." New York, Interscience Publishers, 1961.

Hafnium and zirconium are chemically analyzed. The analysis includes the history, occurrence, industrial processes involving zirconium, toxicology and industrial hygiene, properties, sampling of zirconium-containing materials, separation and isolation of zirconium and hafnium, detection and identification, determination methods for natural and irradiated zirconium and hafnium, analysis of zirconium metal and its alloys, determination of zirconium in specific materials, and selected laboratory procedures. The bibliography contains 253 references. (N.W.R.)

8702 THORIUM. F. S. Grimaldi (U. S. Geological Survey, Washington, D. C.). p.139-216 of "Treatise on Analytical Chemistry. Part II. Analytical Chemistry of the Elements. Volume 5." New York, Interscience Publishers, 1961.

Thorium is chemically analyzed. The analysis includes the occurrence, industrial processes, toxicology and industrial hygiene, properties, separation and isolation, detection and identification, determination methods, analysis of thorium metal and its alloys, analysis of compounds, and selected laboratory procedures. The bibliography contains 235 references. (N.W.R.)

8703 PHOSPHORUS. William Rieman, III (Rutgers Univ., New Brunswick, N. J.) and John Beukenkamp. p.317-402 of "Treatise on Analytical Chemistry. Part II. Analytical Chemistry of the Elements. Volume 5." New York, Interscience Publishers, 1961.

Phosphorus is chemically analyzed. The analysis includes the occurrence, industrial processes, toxicology and industrial hygiene, properties, sampling, separation and isolation, detection methods, determination methods, determination of compounds of phosphorus, determination in specific materials, and laboratory procedures. The bibliography contains 288 references. (N.W.R.)

8704 IMPROVEMENTS IN OR RELATING TO MOISTURE CONTENT DETERMINATION. (to Beloit Iron Works). British Patent 887,556. Jan. 17, 1962.

A microwave apparatus is designed for estimating the moisture content of solid materials, e.g., paper products. The apparatus is relatively insensitive to density variations in the material and comprises a microwave signal generator, waveguide means for projecting the signal along a surface of the material, and means for measuring the amount of microwave energy absorbed thereby. (D.L.C.)

8705 METHOD OF DETERMINING SMALL QUANTITIES OF WATER VAPOUR IN GASES. Fred Berry Waddington (to Associated Electrical Industries, Ltd.). British Patent 889,140. Feb. 7, 1962.

A method is given for determining trace quantities of water vapor in a gas, e.g., CO_2 from gas-cooled reactors. The method comprises diluting a Karl Fischer reagent with dry methanol until an equivalence of 0.10 to 0.50 mg water per ml is attained, and then passing the gas at a known rate through a known volume of the diluted reagent until the dark brown color of the reagent is dispelled, which indicates water vapor. (D.L.C.)

General Inorganic and Physical Chemistry

8706 (AAEC/E-81) DETERMINATION OF THE STABILITY CONSTANTS OF SALICYLATO–BERYLLIUM COMPLEXES BY A DISTRIBUTION METHOD. L. E. Szego (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Nov. 1961. 16p.

An investigation of the solvent extraction behavior of salicylato–beryllium complexes is reported. A simplified method for calculating the stability constants has been developed. The values obtained are $\beta_1 = 4.0 \times 10^{12}$ and $\beta_2 = 4.3 \times 10^{22}$ in 0.15 M sodium perchlorate. (auth)

8707 (AERE-R-3710) A STUDY OF THE PURIFICATION OF NITROGEN BY URANIUM NITRIDE. K. E. Francis and N. Hodge (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Oct. 1961. 25p.

Uranium nitride was investigated as an agent for the removal of impurities from nitrogen at high temperatures. It was found that oxygen was readily removed, and water and carbon dioxide were converted into hydrogen and carbon monoxide at moderately elevated temperatures. Uranium nitride was unreactive to hydrogen, however, and was rapidly deactivated by carbon monoxide. It is concluded that the conventional chemical methods for the purification of nitrogen are more convenient; the optimum system consists of an oxidation and a reduction step in combination with beds for the removal of carbon dioxide and water. If oxygen is in excess of the reducing gases, the oxidation process may be eliminated. A brief examination was also made of the efficiency of the more common drying agents. (auth)

8708 (AWRE-O-53/61) A PRELIMINARY EXAMINATION OF LITHIUM TETRABORATE. J. H. Sant and D. R. Gregory (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Nov. 1961. 8p.

Experimental observations on the dehydration, composition, water absorption, density, and melting point are reviewed, for the pentahydrate of lithium tetraborate. (auth)

8709 (CEI-62(Rev.)) THE ABSORPTION OF PLUTONIUM BY ANION RESINS. R. W. Durham and R. Mills (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nov. 1953. Revised and Reprinted, Oct. 1961. 17p. (AECL-1399).

Equilibrium experiments have shown Pu^{4+} to be absorbed from nitric acid onto an anion resin as a complex anion $Pu(NO_3)_6^{2-}$. The amount of absorption is dependent on the plutonium and nitric acid concentrations in the equilibrium solution with a maximum at 7N to 8N HNO_3. A low cross-linked resin has a higher capacity and reaches equilibrium more rapidly than the normally supplied resin. Saturation capacity of one per cent cross-linked Nalcite SBR (Dowex 1), 50 to 100 mesh, is 385 mg Pu/gram dry resin. (auth)

8710 (GAT-T-961) REDUCTION OF URANIUM(VI) TO URANIUM(IV) WITH SULFUR. G. A. Rampy (Goodyear Atomic Corp., Portsmouth, Ohio). Nov. 22, 1961. Contract AT(33-2)-1. 3p.

Based on GAT-ID-32.

Elemental sulfur can be used in a variety of reductions to effect the reduction of uranium compounds in conjunction with their conversion to uranium tetrafluoride. Uranyl fluoride can be reduced by sulfur to a mixture of uranium dioxide and uranium tetrafluoride. Uranyl fluoride, uranium trioxide, or uranosic oxide can be reduced to uranium tetrafluoride in a single-step process using sulfur and either ammonium fluoride (or bifluoride) or hydrogen fluoride. (auth)

8711 (HW-69697) A METHOD FOR THE PREPARATION OF THE DIBUTYL ESTER OF PHOSPHORIC ACID.

C. W. Pollock (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 23, 1961. Contract [AT(45-1)-1350]. 2p.

A process for the preparation of dibutyl phosphate by hydrolysis of tributyl phosphate with methanolic potassium hydroxide is described. (auth)

8712 (IFA-DF-13) THE ISOTOPIC EQUILIBRIUM OF HYDROGEN–WATER SYSTEM. D. Barb and V. Mercea (Academia R. P. R. Institutul de Fizica Atomica, Bucharest).

A discussion is given of the use of spectroscopic data in the computation of the complex equilibrium constants for the intermediate region of concentrations at normal pressures and temperatures of 250 to 900°K. The results are tabulated and graphed such that the isotopic content of the system can be obtained immediately at equilibrium either in the region of intermediate or extreme concentrations. (B.O.G.)

8713 (NEPA-1841) HYDRIDES AND METAL–HYDROGEN SYSTEMS. Final Report. Thomas R. P. Gibb, Jr. (Metal Hydrides Inc., Beverly, Mass.). Apr. 30, 1951. Decl. July 18, 1961. For Fairchild Engine and Airplane Corp. NEPA Div., Oak Ridge, Tenn. Contract [W-33-08-ac-14801(16250)]. Subcontract SC-2026. 73p.

The work reported deals with the preparation and physical properties, especially thermal dissociation pressures, and densities of hydrides, hydrogen–metal systems, and mixtures of hydrides with other substances. Possible applications as moderators, high-temperature neutron shields, and low-temperature shields are cited and design problems discussed. Most of the data on dissociation pressures cover ranges and compounds not hitherto explored because of experimental difficulties and the basic knowledge of the thermal behavior of hydrides was substantially increased. New hydrides were prepared and several reported in the literature were shown not to exist. The following compounds, mixtures, and systems were studied: Ti–H, U–H, Li–H, Na–H, Ca–H, Ba–H, Th–H, Sr–H; NaH–NaF, NaH–NaOH, NaH–CaH_2, LiH–LiF, CaH_2–CaF_2, CaH_2–CaC_2, CaH_2–Ca_3N_2; FeH_3 (alleged), NiH_2 (alleged), $Ti(BH_4)_3$, $Th(BH_4)_4$, WH_4 (attempted), $W(BH_4)_4$ (attempted), AlH_3, $LiBH_4$, $(CH_3)_4NBH_4$, $(CH_3CH_2)_4NBH_4$, and $(CH_3)_3BzNBH_4$. Among the hydrides are compounds having an N_H comparable to water yet stable at red heat, compounds giving a neutron shield weight less than half that of water, and compounds suitable for use as high-temperature moderators containing large amounts of hydrogen. (auth)

8714 (NP-11241) RESEARCH ON PHASE EQUILIBRIA BETWEEN BORON OXIDES AND REFRACTORY OXIDES, INCLUDING SILICON AND ALUMINUM OXIDES. Quarterly Progress Report (Report No. 7), April 1, 1961–June 30, 1961. P. J. Gielisse, T. J. Rockett, and W. R. Foster (Ohio State Univ. Research Foundation, Columbus). July 18, 1961. Contract AF33(616)-6509. 13p.

Progress is reported on developments in phase equilibrium investigations of the systems SiO_2–B_2O_3, Si–B–O, Al_2O_3, and Al_2O_3–B_2O_3–SiO_2. (B.O.G.)

8715 (NP-11290) BIBLIOGRAPHY OF RARE EARTH USE AS CATALYSTS AND AS CATALYST PROMOTERS AND ACTIVATORS. (Lindsay Chemical Co., West Chicago, Ill.). Apr. 1956. 28p.

An annotated bibliography is presented, consisting of 141 references to material on rare earth uses as catalysts and as catalyst promoters and activators. (T.F.H.)

8716 (NP-11352) URANIUM: ANTIMONIDES, ARSENIDES, PHOSPHIDES, SELENIDES, SULFIDES, AND TELLURIDES. AN ANNOTATED BIBLIOGRAPHY. A. M. Armstrong, Anne Brearley, and I. H. Warren, comps. (Canadian Uranium Research Foundation, Toronto). Jan. 1962. 27p.

A bibliography of 135 references is presented for the preparation and properties of U compounds with Sb, As, P, Se, S, and Te. The references are arranged in sections corresponding to the different U compounds, and each section is arranged chronologically. (D.L.C.)

8717 (ORNL-3241) THE CHEMISTRY OF NIOBIUM IN PROCESSING OF NUCLEAR FUELS. T. A. Gens (Oak Ridge National Lab., Tenn.). Feb. 5, 1962. Contract W-7405-eng-26. 18p.

The chemical and industrial literature and laboratory work concerned with processing of niobium-containing nuclear fuels are reviewed. 57 references. (auth)

8718 (ORO-325(Pt.2)) MATERIALS FOR HIGH TEMPERATURE NUCLEAR ENGINEERING APPLICATIONS. Progress Report No. 2, Part 2, August 15, 1959 to August 15, 1960. J. D. Fleming and J. W. Johnson (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Contract AT-(40-1)-2483. 30p.

The possibilities of forming refractory mixtures (thermets) through exothermic reactions are being investigated. Systems were designed for use in thermal and thermogravimetric analysis of these thermets in inert or oxidizing environments. Thermet reductions of UO_2 by Al or Be were conducted in which reactions below 2000°F were indicated, however the reaction mechanism was not established. (J.R.D.)

8719 (ORO-508) PRECISE MEASUREMENTS WITH GLASS ELECTRODES: THE ACTIVITY COEFFICIENTS OF HCl AT 50 AND 65°C. Final Report. H. Lawrence Clever ([Emory Univ., Atlanta]). [1961]. Contract AT-(40-1)-2569. 17p.

A discussion is given of the methods and results of measurements of activity coefficients of HCl in aqueous solutions using the cell system: glass electrode–HCl–AgCl(s)–Ag, in which the hydrogen ion potential is the electrode potential. Combining the potentials of the cell at two acid concentrations at the time of moving the electrode system from one solution to the other, gives a potential identical to that obtained from the cell without transference. Results of the measurements at 50 and 65°C are tabulated. (B.O.G.)

8720 (TID-14428) STUDIES OF H_2^+ DISSOCIATION. Interim Annual Report. A. W. Ehler (Hughes Research Labs. Div. of Hughes Aircraft Co., Malibu, Calif.). Dec. 11, 1961. Contract AT(04-3)-362. 14p.

Results are reported from an investigation to determine the fraction of H molecular ions (H_2^+) which are dissociated by an electric field into which ions were injected. The fraction dissociated was found to be 0.005 for fields at 560,000 v/cm and 0.0031 for fields at 97,000 v/cm. (J.R.D.)

8721 (TID-14660) ISOTOPE EXCHANGE AND ISOTOPE EFFECTS IN THE REACTIONS OF ORGANOLITHIUM COMPOUNDS. Technical Progress Report. Robert West (Wisconsin. Univ., Madison). Dec. 1961. Contract AT(11-1)-64. 4p.

A study of the infrared spectra of t-butyllithium was undertaken. The spectrum of t-$BuLi^7$ mulled in Nujol showed bands at 580, 522, 479, and 415 cm^{-1} whereas the spectrum of t-$BuLi^6$ mulled in Nujol showed bands at 608, 538, 500, and 429 cm^{-1}. The reaction of ethyllithium with t-butyllithium was investigated. The decomposition of sec-butyllithium was investigated and 1-butene and two iso-

meric 2-butenes were identified. Attempts to obtain crystals of t-butyllithium were unsuccessful. (M.C.G.)

8722 (TID-14778) BIBLIOGRAPHY [ON] FLUOROCARBON COMPOUNDS. Marjorie Comstock (Brookhaven National Lab., Upton, N. Y.). Nov. 20, 1961. Contract [At(30-2)-Gen-16]. 40p.

A bibliography of 582 references is presented on perfluoro compounds of alkanes, alkenes, alkadienes, alkatrienes, alicyclics, and aromatics. Compounds containing less than 3 fluorine atoms and substituted compounds are omitted. A compound index is included. (D.L.C.)

8723 (TID-14787) MECHANISM OF THE RADIATION-INDUCED ADDITION OF TRITIUM TO CARBON–CARBON DOUBLE BONDS. Progress Report. (Illinois. Univ., Urbana). [1961]. Contract AT(11-1)-890. 11p.

Studies were made on the addition of tritium to cyclohexene and some of its derivatives. The mechanism of the formation of cyclohexane-H^3 and cyclohexene-H^3 in the tritiation of cyclohexene was studied. Tritiation of 3-bromocyclohexene, but not of cyclohexadiene-1,3, was found to be a good method for preparing cyclohexene-H^3, and the distribution of tritium in the cyclohexene-H^3 obtained in various tritiation experiments was determined. Competitive tritiation experiments were carried out on cyclohexene–cyclohexadiene-1,3 and cyclohexene–benzene. No electron spin resonance evidence was found for the formation of free radicals in the tritium-cyclohexene interaction. An experiment with cyclohexene–acetone shows that acetone cannot predominate over cyclohexene as a scavenger for tritium atoms. (D.L.C.)

8724 (TID-14788) MECHANISMS OF INORGANIC OXIDATION-REDUCTION REACTIONS IN NONAQUEOUS MEDIA. Technical Progress Report for 1961. ([Minnesota. Univ., Minneapolis]). Contract AT(11-1)-622. 22p.

Measurements were carried out on the Fe^{59} exchange of Fe^{2+} and Fe^{3+} in aqueous sulfate solutions at constant ionic strength and pH. The results for $[H^+] = 0.100$ M are consistent with an exchange mechanism involving $Fe^{2+}(aq) - Fe^{3+}(aq)$ and $Fe^{2+}(aq) - Fe(OH)^{2+}$ exchange as well as $Fe^{2+}(aq) - FeSO_4^+$ and $Fe^{2+}(aq) - Fe(SO_4)_2^-$ exchange. Alternate exchange reactions are discussed. Erratic results were obtained at higher pH and at lower iron concentrations and the latter was traced to oxidation. Results are also presented for $[H^+] = 0.200$ M and 0.500 M. (D.L.C.)

8725 (USNRDL-TR-541) COCRYSTALLIZATION OF ULTRAMICRO QUANTITIES OF IRON AND OTHER ELEMENTS WITH OXINE GENERATED IN SITU. H. V. Weiss and W. H. Shipman (Naval Radiological Defense Lab., San Francisco). Oct. 31, 1961. 22p.

The cocrystallization of iron in trace quantities with oxine formed homogeneously in solution by the hydrolysis of 8-acetoxyquinoline was studied. The distribution of microcomponent between the solid phase and the mother liquor was profoundly affected by the degree of supersaturation. After relief from supersaturation, a constant distribution coefficient was calculated by an equation which was predicated upon the Doerner-Hoskins equilibrium. The cocrystallization of other elements was also examined with an arbitrarily established set of conditions. Plutonium, cerium, and praseodymium were quantitatively recovered from solution. (auth)

8726 (WADD-TR-60-782(Pt.VI)) VAPORIZATION OF COMPOUNDS AND ALLOYS AT HIGH TEMPERATURE. PART VI. STUDIES OF THE VAPORS OF THE SYSTEMS Au–Cr AND Au–Pd BY MASS SPECTROMETRY. Marcel Ackerman, Fred E. Stafford, and Georges Verhaegen (Brussels. Université). Aug. 1961. Contract AF61(052)-225. 16p.

The molecules Au-Cr and Au-Pd have been identified. From the data for the reaction $Au_2 + X = AuX + Au$, and $D_0^0(Au_2) = 51.5$ kcal/mole: $D_0^0(AuCr) = 50.4 \pm 3.5$ kcal/mole; and $D_0^0(AuPd) = 33.3 \pm 5$ kcal/mole. (auth)

8727 (AEC-tr-5005) A METHOD FOR OBTAINING ANODE CURVES BY MEANS OF CATHODE POLARIZATION. E. N. Mirolyubov (Miroliubov), M. M. Kurtepov, and N. D. Tomashov. Translated by Lydia Venters (Argonne National Lab., Ill.) from Trudy Inst. Fiz. Khim., Akad. Nauk S.S.S.R., No. 7, 51-3(1959). 5p.

On the basis of the present conceptions on the cathode protection of metals and alloys, a method for obtaining true anode polarization curves in the region of potentials more negative than the stationary, i.e. at the cathode external polarization, was worked out. This method provides for the determination of weight losses in samples at a preset potential which is maintained by means of the cathode polarization from the external voltage source. Also the design of a sample holder is suggested. (auth)

8728 (JPRS-11289) THE OSCILLATIONAL STRUCTURE OF THE ELECTRON SPECTRA OF URANYL NITRATE. Adam Bartecki and Boguslawa Jezowska-Trzebiatowska. Translated from Nukleonika, 6: 267-75; 277-85; 287-94(Apr. 1961). 25p.

The vibrational structure analysis of the electronic absorption spectra of uranyl nitrate in organic solvents showed that the electronic and vibrational transition energies and the magnitude of the quantum of the completely symmetrical oscillations of the uranyl ion in the excited state depend on the type of solvent. The quantum value was used for calculation of the symmetrical force constants, which enabled the determination of excited state U-O distances. The spectra appear to be represented by progression, which has a convergence limit caused by anharmonic vibrations of the uranyl ion. This limit was calculated using the Virge-Sponer method. The approximate value of the dissociation energy of the uranyl ion in the excited state is 3.55 ev. The oscillator forces of the electron-oscillation spectra and of some oscillational transitions and the value of the $\int \epsilon_n \, d\sigma$ integral have been calculated. It was shown that in the spectra in which the characteristic intensity distribution is retained, the constant half-width $\Delta\sigma = 3000$ cm^{-1} can be accepted. Some specific problems relating to the electronic transitions in the spectra are discussed. (B.O.G.)

8729 THE CRYSTAL STRUCTURES OF CAESIUM, AMMONIUM AND POTASSIUM PERTECHNETATES. B. J. McDonald and Gwyneth J. Tyson (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.). Acta Cryst., 15: 87(Jan. 10, 1962).

The crystal structures of cesium, ammonium, and potassium pertechnetates were determined from powder photographs. The structures of ammonium and potassium pertechnetates were confirmed as tetragonal, space group $I4_1/a$, $CaWO_4$ type. The lattice parameters were found to be $a_0 = 5.790$, $c_0 = 13.310$ Å for NH_4TcO_4 and $a_0 = 5.654$, $c_0 = 13.030$ Å for $KTcO_4$. The structure of $CsTcO_4$ was found to be orthorhombic with lattice parameters $a_0 = 5.718$, $b_0 = 5.918$, $c_0 = 14.304$ Å. The space group is Pnma. (P.C.H.)

8730 UNIT CELL AND SPACE GROUP OF $LiBrO_3$. John H. Burns (Oak Ridge National Lab., Tenn.). Acta Cryst., 15: 89-90(Jan. 10, 1962).

The unit-cell dimensions and possible space groups for

lithium bromate were determined by single-crystal Weissenberg and precession methods. Lithium bromate is primitive orthorhombic and has unit-cell dimensions a = 5.99 ± 0.02, b = 7.86 ± 0.02, c = 5.06 ± 0.02 Å. Systematic absences indicate that the space group is Pnma or $Pn2_1a$. The crystal structure of $NaIO_3$ is given for comparison purposes. (P.C.H.)

8731 ON THE EXISTENCE OF A COMPOUND IN THE SYSTEM YTTRIUM–URANIUM–OXYGEN. George A. Chase (General Electric Co., Cincinnati). Acta Cryst., 15: 91(Jan. 10, 1962).

The fully oxidized compound, which has the ideal formula $UO_3 \cdot 3Y_2O_3$, in the oxygen-uranium-yttrium system was examined by x-ray powder diffraction. It is indicated that the rhombohedral phase has an extended range of homogeneity. The hexagonal cell constants are a = 9.999, c = 9.358 Å. The hexagonal indexes are tabulated. (P.C.H.)

8732 SYNTHESIS AND SPECTRA OF DEUTERO-TRINITROMETHANE. S. S. Novikov, K. K. Babievskii, and V. A. Shlyapochnikov (Inst. of Organic Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 141: 875-6(Dec. 1, 1961). (In Russian)

Deuteronitromethane was synthesized by reacting DCl with a suspension of potassium trinitromethane in methylene chloride: $(NO_2)_3\,CK + DCl \rightarrow (NO_2)_3\,CD + KCl$. The isotopic content of the deuterated product was 98.5% as determined mass-spectroscopically. The physical properties (density, refractive index, melting point and boiling points) of the deuterated product are almost the same as ordinary trinitromethane. Spectral analysis shows a region at 2266 to 2270 cm^{-1} due to oscillations around the carbon-deuterium bond (C-D). These data on vibratory frequencies can be used in calculations involving the oscillation frequencies of the trinitromethyl group. (TTT)

8733 OXIDATION-REDUCTION POTENTIAL OF U^{3+}/U^{4+} IN A NaCl – KCl MELT. M. V. Smirnov and O. V. Skiba. Doklady Akad. Nauk S.S.S.R., 141: 904-7(Dec. 1, 1961). (In Russian)

UCl_4 in an equimolar mixture of NaCl–KCl was titrated potentiometrically with metallic uranium at a temperature of 690 to 810°C against a comparison electrode of chlorine. A recording Pt or Mo electrode was used to agitate the melt solution and to take the potential. The oxidation-reduction potential $E^0_{U^{3+}/U^{4+}}$ with respect to the chlorine comparison electrode potential was found to a straight-line function of the temperature: $E^0_{U^{3+}/U^{4+}} = -1.906 + 4.83 \times 10^{-4}$ T volts. From the relationship that $E^0_{U/U^{3+}} = -3.010 + 6.65 \times 10^{-4}$ T (volts) it was calculated that $E^0_{U/U^{4+}} = -2.734 + 6/14 \times 10^{-4}$ T (volts). The heat of formation and entropy for the reaction U (solid) + 2 Cl_2 (gas) = UCl_4 (liquid) were found to be: ΔH_{UCl_4} (liq.) = −252,206 cal/mol and ΔS_{UCl_4} (liq.) = −5341 cal/deg.-mole. The equilibrium constant for the reaction $3U^{4+}$ (solution) + U (solid) $\rightleftharpoons 4U^{3+}$ (solution) was found to be: lg K = −3.0845 + 16,690/T. Thus, uranium trichloride in a NaCl–KCl melt is stable over this temperature range (disproportionation of UCl_3 to UCl_4 and U should begin only at temperatures about 5000°C). (TTT)

8734 THE INTERACTION OF BISMUTH CHLORIDE WITH ALKALI METAL CHLORIDES. I. F. Nichkov, O. A. Ryzhik, and S. P. Raspopin (Kirov Urals Polytechnic Inst., USSR). Doklady Akad. Nauk S.S.S.R., 141: 1113-16(Dec. 11, 1961). (In Russian)

The equilibrium potential of metallic bismuth in a NaCl–KCl fused salt electrolyte having a varying content of bismuth chloride (1.13, 3.05, and 12.06 wt.% Bi) was determined at 700 to 850°C with respect to a chlorine comparison electrode by means of a high-resistance potentiometer. The emf of the cell decreases linearly with temperature and with the log of the concentration of bismuth chloride in the melt. It was found that $E_1 = 1.001 - 0.0650$ lg $[Bi^{3+}]$ at 700°C, $E_2 = 0.983 - 0.0665$ lg $[Bi^{3+}]$ at 750°C and $E_3 = 0.963 - 0.0695$ lg $[Bi^{3+}]$ at 800°C. If it is postulated that the behavior of $BiCl_3$ in solution is ideal, the emf of the cell Bi|$BiCl_3$ (fused)|Cl_2, C can be calculated from the experimental data: $E_{cell} = 1.338 - 3.376 \times 10^{-4}$ T. The temperature relation calculated from the literature is: $E_T = 1.254 - 5.750 \times 10^{-4}$ T. The difference $E_{cell} - E_T = 0.084 - 2.374 \times 10^{-4}$ T is a measure of the formation of $BiCl_4^-$ in the NaCl–KCl fused salt mixture. The change in isobaric potential in going from pure fused $BiCl_3$ to a dilute solution can be calculated as: $\Delta Z_{mix} = -3F(E_{cell} - E_T) = -5811 - 16.42$ T cal/moles. As is evident, mixing of the salts leads to the evolution of heat ($\Delta H_{mix} = 5.81$ kcal) and to an increase in entropy ($\Delta S_{mix} = 16.42$ cal/deg.-mol. The fact that heat is evolved is evidence of the formation of $BiCl_4$. (TTT)

8735 PHASE EQUILIBRIA IN THE TERNARY FUSED-SALT SYSTEM LiF–BeF_2–UF_4. L. V. Jones, D. E. Etter, C. R. Hudgens, A. A. Huffman, T. B. Rhinehammer, N. E. Rogers, P. A. Tucker, and L. J. Wittenberg (Monsanto Research Corp., Miamisburg, Ohio). J. Am. Ceram. Soc., 45: 79-83(Feb. 1962). (MLM-1080)

The phase diagram for the ternary fused-salt system LiF–BeF_2–UF_4 was determined from 300°C to the liquidus by differential thermal analysis, thermal-gradient quenching studies, and high-temperature filtration techniques. The samples prepared by quenching were examined by polarized-light microscopy and x-ray diffraction techniques. The experimental methods are described. The primary-phase fields for the compounds LiF, $7LiF \cdot 6UF_4$, $LiF \cdot 4UF_4$, and UF_4 covered most of the liquidus surface. Small areas of the liquidus surface were covered by the compounds BeF_2, $2LiF \cdot BeF_2$, and $4LiF \cdot UF_4$. The compound $4LiF \cdot UF_4$, which was stable at the binary liquidus temperature, decomposed in the ternary system when the liquidus temperature decreased below 480°C. No ternary compounds or solid solutions were observed. Two ternary eutectics were found. The first, containing 48 mole% LiF, 51.5 mole % BeF_2, and 0.5 mole % UF_4, melted at 350°C. The second, containing 69.5 mole % LiF, 22.5 mole % BeF_2, and 8 mole % UF_4, melted at 427°C. (auth)

8736 PHYSICAL PROPERTIES AND STRUCTURE OF MOLTEN SALTS. George J. Janz (Rensselaer Polytechnic Inst., Troy, N. Y.). J. Chem. Educ., 39: 59-67(Feb. 1962).

A review is given on the physical properties and structures of molten salts and on the experimental techniques used for molten salt studies. The physical properties are discussed according to whether they are spectroscopic, transport, electrical, or thermodynamic. Discussion is also given on the theory of interactions in ionic molten salts. (P.C.H.)

8737 WATER CONTENT OF BIS(2-CHLOROETHYL) ETHER IN EQUILIBRIUM AT 25°C. WITH AQUEOUS MINERAL ACID SOLUTIONS. R. A. Horne (Massachusetts Inst. of Tech., Cambridge). J. Chem. Eng. Data, 7: 1-2 (Jan. 1962).

Results are presented from studies of the solubility of water in bis(2-chloroethyl)ether, a solvent used extensively for extraction studies of halide complexes of trivalent elements. The equilibrium molar concentrations of water and electrolyte in the ethereal phase are plotted against the equilibrium molar concentrations of the various electrolytes (HNO_3, $HClO_4$, HCl, LiCl, HBr, and H_2SO_4) in the aqueous phase. The solubility of water in the ether as a function of

temperature is also shown. The extractability of the mineral acids ($HNO_3 > HClO_4 \gg HBr$, HCl, H_2SO_4) agrees with predictions based on considerations of acid strength, molecular size, and solvation. It is shown that $HClO_4$, and especially HNO_3, extract in basic organic solvents better than hydrohalic acids and that H_2SO_4 does not extract at all. The solubility of water in the ethereal phase parallels the solubilities of these acids in the ethereal phase based on the data. (N.W.R.)

8738 CONDUCTIVITY OF HYDROFLUORIC ACID SOLUTIONS AND THE EFFECT OF THE IMPURITIES, SULFUROUS AND HYDROFLUOSILICIC ACIDS. S. J. Broderick (U. S. Atomic Energy Commission, New Brunswick, N. J.). J. Chem. Eng. Data, 7: 55-7(Jan. 1962).

The effect of impurities (H_2SiF_6 and H_2SO_3) on the conductivity of hydrofluoric acid solutions (1 to 48%) at 25 to 115.5°C is investigated. The results show that conductance increases with temperature to a maximum and the impurities increase the conductivity. However as the concentration of the hydrofluoric acid increases to about 30%, the effect of the added impurities decreases and finally disappears. The cause of this decrease is not known; however at lower concentrations the conductivity is increased by the impurities on the basis of simple ionic abundance. (N.W.R.)

8739 HIGH TEMPERATURE ENTHALPY, HEAT CAPACITY, HEAT OF FUSION, AND MELTING POINT OF ZIRCONIUM TETRAFLUORIDE. R. A. McDonald, G. C. Sinke, and D. R. Stull (Dow Chemical Co., Midland, Mich.). J. Chem. Eng. Data, 7: 83(Jan. 1962).

Thermodynamic properties of zirconium tetrafluoride were measured at 283.9 to 1226°K. Premelting is evident, starting between 1114 and 1165°K; melting is complete at 1205°K. The heat of fusion is 15350 cal/mole. The heat capacity of the liquid is indicated to be about 29 cal/mole deg, but little confidence can be placed in this figure. Enthalpy is given from 283.9 to 1225.8°K and ranges from −372.4 to 43407 cal/mole. (N.W.R.)

8740 LIQUID DENSITY OF YTTRIUM AND SOME RARE-EARTH FLUORIDES FROM THE MELTING POINTS TO ≅ 2500°K. A. D. Kirshenbaum and J. A. Cahill (Temple Univ., Philadelphia). J. Chem. Eng. Data, 7: 98-9(Jan. 1962).

The liquid densities of cerium, lanthanum, praseodymium, samarium, and yttrium trifluorides are presented at temperatures from the melting point to 2600°K. From the density values obtained the molar volumes and cubical thermal coefficients of expansion are calculated. The densities at the melting and boiling points are: cerium trifluoride, 4.631 g/cc(1733°K) and 3.819 g/cc(2600°K); lanthanum trifluoride, 4.634 g/cc(1700°K) and 4.020 g/cc (2600°K); praseodymium trifluoride, 4.862 g/cc(1643°K) and 4.192 g/cc(2600°K); samarium trifluoride, 4.879 g/cc (1670°K) and 4.362 g/cc(2600°K); and yttrium trifluoride, 3.808 g/cc(1660°K) and 3.376 g/cc(2500°K). (N.W.R.)

8741 ELECTRICAL CONDUCTANCE CELL ASSEMBLY FOR USE WITH AQUEOUS SOLUTIONS UP TO 800°C AND 4000 BARS. E. U. Franck, J. E. Savolainen, and William L. Marshall (Oak Ridge National Lab., Tenn.). Rev. Sci. Instr., 33: 115-17(Jan. 1962).

An electrical conductance cell assembly, designed for use with aqueous solutions at extremes of temperature and pressure, is described. Its utility was demonstrated by measurements of the conductance of 0.010 molal KCl solution at 800°C and at pressures up to 4000 bars. (auth)

8742 PHYSICO-CHEMICAL PROPERTIES OF HYDRATED URANIUM PEROXIDE COMPOUNDS. E. Ya. Rode, Z. S. Golovleva, V. G. Kuznetsov, and P. A. Koz'min (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 2635-48(Dec. 1961). (In Russian)

The physico-chemical properties of hydrated uranium tetroxide preparations synthesized under various conditions are studied, and thermal decomposition processes are analyzed. Three hydrated peroxide compounds, $UO_4 \cdot 4H_2O$, $UO_4 \cdot 2H_2O$, and $UO_{3.5} \cdot nH_2O$, where n = 3 to 1.4, were prepared. The differential thermogram of $UO_4 \cdot 4H_2O$ shows two endothermal effects at 75 to 135 to 165°C and 165 to 225°C. The first forms hydrated trioxide with an intermediate peroxide compound $UO_{3.5} \cdot nH_2O$ (at 135°), the second produces UO_3, which recrystallizes at 495 to 510°C forming finally U_3O_8. The formation of the intermediate $UO_{3.5} \cdot nH_2O$ indicates that the products are typically peroxide. (R.V.J.)

8743 COMPLEXING OF U(IV) WITH COMPLEXONE III. P. N. Palei and Li-Yüan Hsü. Zhur. Neorg. Khim., 6: 2649-53(Dec. 1961). (In Russian)

In strong acid solution U(IV) with complexone III forms a complex compound with a molecular ratio of 1:1 and in weak acid 1:2. Complexing takes place even in solutions with normal acidity. The complex compounds of U(IV) with complexone(III) are unstable in alkali media; at pH ≥ 10, $U(OH)_4$ precipitates. In acid media of pH 0.6 to 2.0, neutral, anionic, and cationic complexes appear simultaneously. (R.V.J.)

8744 COMPLEX FORMATION OF Pu(IV) WITH SULFATE ION. I. N. Marov and M. K. Chmutova (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 2654-62(Dec. 1961). (In Russian)

A cation exchange analysis is made of Pu(IV) complexing with HSO_4^-. It was found that with ionic strength $\mu = 2.33$ and $H^+ = 2.33$ mol/l plutonium forms $PuSO_4^{2+}$ with a stability constant of $(3.02 \pm 0.4) \times 10^2$. It is also shown that Pu forms three complexes; $PuSO_4^{2+}$, $Pu(SO_4)_2$, and $Pu(SO_4)_3^{2-}$ with equilibrium constants 9.45, 20.0, and 125 at H^+ concentration of 0.5 mol/l and H_2SO_4 concentration of 0 to 0.2 mol/l. Certain similarities and non-monotonous changes are observed in the initial equilibrium constants, complexing reactions, and initial hydrolysis constants of Zr^{4+}, Hf^{4+}, Pu^{4+}, Ce^{4}, Np^{4+}, U^{4+}, and Th^{4} that are related to ion radius. (R.V.J.)

8745 COMPLEX COMPOUNDS OF THORIUM WITH TETRAOXYADIPIN ACID. O. E. Zvyagintsev and L. G. Khromenkov (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 2663-7(Dec. 1961). (In Russian)

Physico-chemical analysis was made of thorium nitrate reactions with the sodium salt of mucic acid in a wide range of pH. The compounds $(ThOH)_2(H_4Sls)_3 \cdot 6H_2O$, $NaTh(OH)H_2Sls \cdot 2H_2O$, $NaTh(OH)(H_4Sls)_2 \cdot 6H_2O$, and $Na_2Th(OH_2)(H_4Sls)_2 \cdot 10H_2O$ (where Sls is mucic acid) were prepared, and their structural formulas are postulated. The first and second constants of mucic acid dissociation were estimated, and the instability constant of the $(ThH_4Sls)^{2+}$ type cation complex was calculated. Correlations were made with the stabilities of thorium complexes with malic, tartaric, triglutaric, and mucic acids in alkali media. (R.V.J.)

8746 PROPERTIES OF COMPLEX COMPOUNDS FORMED BY RARE EARTH ELEMENTS AND ETHYLENEDIAMINETETRAACETIC ACID. L. I. Martynenko (Moscow State Univ.). Zhur. Neorg. Khim., 6: 2704-12(Dec. 1961). (In Russian)

Reactions of Ln_4A_3 complex compounds with alkali,

organic solvents, and ion exchange resins and crystallization and electric conductivity studies indicate the presence of a bond between ethylenediaminetetraacetic acid and non-complexed rare earth in the the Ln_4A_3 molecule. Such bonds are stronger in the cerium subgroup than in the yttrium elements. The separation coefficients, evaluated by the difference in cationic sorption, of Ln_4A_3 type complexes formed with Sm, Y, and Er are 22.8 for the Sm/Er, 7.3 for Y/Er, and 3.2 for Sm/Y pairs. (R.V.J.)

8747 ARGENTOCYANIDES OF La, Pa, Nd, Sm, AND Gd. R. A. Chupakhina, Yu. V. Indukarev, and V. V. Serebrennikov. Zhur. Neorg. Khim., 6: 2713-15(Dec. 1961). (In Russian)

Preparation and crystallographic properties of La, Pa, Nd, Sm, and Gd argentocyanides of the composition $Me[Ag(CN)_2]_3 \cdot 3H_2O$ are described. The solubility of the argentocyanides in water at 25°C was determined. (R.V.J.)

8748 RARE EARTHS AND YTTRIUM ARSENITES. G. I. Vasil'ev and V. V. Serebrennikov. Zhur. Neorg. Khim., 6: 2716-18(Dec. 1961). (In Russian)

Separation of La, Ce, Pa, Nd, Sm, Gd, Dy, Er, Yb, Lu, and Y arsenites of $MeArO_3 \cdot 3H_2O$ composition in aqueous-alcohol solutions (50% alcohol) at pH 6.2 is described, and the solubilities of the separated arsenites in water at 25°C are determined. The minimum in the solubility curve is found near gadolinium. Yttrium is found near dysprosium. (R.V.J.)

8749 NITRIDATION OF POWDERED NIOBIUM. G. V. Samsonov and T. S. Verkhoglyadova (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Zhur. Neorg. Khim., 6: 2732-7(Dec. 1961). (In Russian)

The preparation of a nitride phase in niobium-nitrate systems is described, and the activation energies of Nb_2N and NbN formation are determined as well as the electric conductivity, thermal expansion coefficient, and vapor pressure at 1000 to 1800°C. The relation between energy and thermal characteristics is analyzed. (R.V.J.)

8750 REACTION OF BORON CARBIDE AND BORIDE METALS WITH CaO AND $BaCO_3$ IN SINTERING. M. D. Lyutaya, T. N. Nazarchuk, and K. D. Modylevskaya (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Zhur. Neorg. Khim., 6: 2738-43(Dec. 1961). (In Russian)

Reactions in $B_4C-CaO-O_2$, $B_4C-CaO-CO_2$, $B_4C-BaCO_3-O_2$, and $B_4C-BaCO_3-CO_2$ were studied at 860 and 820°C, and the compositions of solid and gaseous reaction products were found. The compound $Ca_2B_6O_{11}$ was formed in $B_4C-CaO-O_2$, CaB_2O_4 and $Ca_2B_6O_{11}$ were formed in $B_4C-CaO-CO_2$, and $Ba_2B_2O_5$ was formed in $B_4C-BaCO_3-O_2$ and $B_4C-BaCO_3-CO_2$. (R.V.J.)

8751 THERMAL AND TENSIMETRIC STUDIES OF $ZrCl_4-AlCl_3-KCl$ AND $ZrCl_4-FeCl_3-KCl$ SYSTEMS. I. S. Morozov and L. Tsegledi (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR and Inst. of Chemistry, Academy of Sciences, Rumanian Peoples Republic, Klyzh Branch). Zhur. Neorg. Khim., 6: 2766-75(Dec. 1961). (In Russian)

Chemical reactions of $ZrCl_4$, $AlCl_3$, and KCl during crystallization were studied, and the liquidus surface for $ZrCl_4-AlCl_3-KCl$ was constructed. The boundaries for the primary crystallizations of KCl, K_2ZrCl_6, $ZrCl_4$, $KAlCl_4$, $AlCl_3$, $KFeCl_4$, and $FeCl_3$ are determined. Tensimetric studies of $ZrCl_4-AlCl_3-KCl$ and $ZrCl_4-FeCl_3-KCl$ show that KCl and NaCl can be used for separating $ZrCl_4$ from $AlCl_3$ and the basic mass of iron chlorides. The Fe_2Cl_6 vapor pressure is very slightly dependent on temperature and is of the magnitude 1.8 to 3.3 mm mercury. (R.V.J.)

8752 COMPREHENSIVE INORGANIC CHEMISTRY. Robert C. Brasted. Volume Eight. Sulfur, Selenium, Tellurium, Polonium, and Oxygen. Princeton, N. J., D. Van Nostrand Company, Inc., 1961. 314p.

Emphasis is placed largely on chemical properties and relationships and their interpretation in terms of theoretical concepts of atomic and molecular structure, the deductions from the periodic system, and the basic ideas relating to theories of solution. Information is also presented on the history, occurrence, preparation, compounds, separation processes, and uses of the elements. (N.W.R.)

8753 IMPROVEMENTS IN OR RELATING TO PLUTONIUM COMPOUNDS. Lewis Eric Russell (to United Kingdom Atomic Energy Authority). British Patent 887,953. Jan. 24, 1962.

Methods are given for preparing compounds of the formula $MPuO_3$ or $PuMO_3$ and of the perovskite structure. The compounds include $BaPuO_3$, $PuAlO_3$, $PuVO_3$, $PuCrO_3$, and $PuMnO_3$, which can be used as nuclear fuel material with the possible exception of $PuMnO_3$. (D.L.C.)

8754 METHOD OF COMBINING HYDROGEN AND OXYGEN. J. P. McBride (to U. S. Atomic Energy Commission). U. S. Patent 3,023,085. Feb. 27, 1962.

A method is given for the catalytic recombination of radiolytic hydrogen and/or deuterium and oxygen resulting from the subjection of an aqueous thorium oxide or thorium oxide–uranium oxide slurry to ionizing radiation. An improved catalyst is prepared by providing palladium nitrate in an aqueous thorium oxide sol at a concentration of at least 0.05 grams per gram of thorium oxide and contacting the sol with gaseous hydrogen to form flocculated solids. The solids are then recovered and added to the slurry to provide a palladium concentration of 100 to 1000 parts per million. Recombination is effected by the catalyst at a rate sufficient to support high nuclear reactor power densities. (AEC)

Radiation Chemistry and Radiochemistry

8755 (AERE-M-921) THE PRODUCTION OF CHEMICALS FROM REACTORS. PART VI. ANHYDROUS HYDRAZINE FROM THE PILE AND FISSION FRAGMENT IRRADIATION OF LIQUID AMMONIA. D. A. Landsman and C. M. Noble (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1961. 20p.

Experiments are described on the synthesis of hydrazine from liquid ammonia under pile radiation and fission fragment bombardment. The yields of hydrazine were found to be respectively 0.11 and 1.10 molecules per 100 ev deposited in the ammonia. (auth)

8756 (CNI-101) SEPARAZIONE DI S-35 CARRIER-FREE DA KCl IRRAGGIATO IN UN REATTORE. (Extraction of Carrier-Free S-35 from KCl Irradiated in a Reactor). M. Bresesti, A. M. Del Turco, R. Lanz, and G. Restelli (Italy. Comitato Nazionale per l'Energia Nucleare. Centro di Studi Nucleari, Ispra). Apr. 1961. 14p.

Carrier-free S^{35} is extracted from irradiated KCl, by adsorbing the S^{35} on an alumina column and eluting with ammonium hydroxide. The S^{35} has a radiochemical purity

higher than 99%. The apparatus used in the preparation of curie quantities of S^{35} is shown. (auth)

8757 (IFA-CO-16) SYNTHESIS OF 2,5-DIARYL-OXAZOLES THROUGH FRIEDEL-CRAFTS REACTION OF AZLACTONES WITH AROMATIC HYDROCARBONS. P. T. Frangopol, A. T. Balaban, L. Birladeanu, and E. Cioranescu (Academia R. P. R. Institutul de Fizică Atomică, Bucharest). 1961. 17p.

2-Phenyl-5-oxazolone (hippuric acid azlactone, I) gives good yields of benzoylaminoketones II in the Friedel-Crafts benzoylaminoacetylation of aromatic hydrocarbons. On this basis a new synthesis of 2,5-diaryloxazoles was devised, resulting in the simplest preparation of several 2-phenyl-5-aryl-oxazoles (III), which are good scintillator solutes. Ultraviolet absorption spectra are described. (auth)

8758 (NP-11262) THE EFFECT OF NUCLEAR RADIATIONS ON BENZENE–WATER SYSTEMS (thesis). Terry Robert Johnson (Michigan. Univ., Ann Arbor). 1959. 200p. (IP-352)

The effects of neutron and γ radiation from a pool-type reactor, and of γ radiation alone from a Co^{60} source, on benzene-water systems are studied. The variables studied include total neutron and γ doses, γ dose rates, neutron fluxes, temperature, benzene and product concentrations, and oxygen concentrations (in aerated water). The major products are found to be phenol and biphenyl. The effects of the two radiation sources are compared, in order to determine the effect of the neutrons. A benzene-saturated water γ dosimeter is developed. (T.F.H.)

8759 (TID-14826) APPLICATION OF FISSION PRODUCT SOURCES IN ORGANIC RADIATION CHEMISTRY. PART I. Progress Report for the Year Ending December 31, 1961. Weldon G. Brown (Chicago. Univ.). Contract AT(11-1)-754. 8p.

A technique was developed for forming Pm^{147}-containing glass surfaces resistant to chemical or mechanical leaching, and two sources of this type were fabricated with 1-curie quantities of Pm^{147}. Dosimetry of a Pm^{147} source of low intensity by decomposition of nitrous oxide and measurement of non-condensable gases was found to be feasible. (D.L.C.)

8760 (TID-14830) [RADIOCHEMICAL RESEARCH]. Annual Progress Report, December 15, 1960 to December 15, 1961. Nathan Sugarman and Anthony Turkevich (Chicago. Univ.). Dec. 15, 1961. Contracts AT(11-1)-104 and AT(11-1)-241. 12p.

The fairly short-lived cosmic-radiation-induced radioactivities of meteorites are used to analyze these meteorites radiochemically. The radiochemical determination of Bi^{205} in Pb from Discoverer XVII is described. Recoil studies are made of the fission fragments from thermal neutron fission of U and 450-Mev proton fission of U, Bi, and Ta. The energetics of high-energy fission are discussed. The recoil of Bi^{203} formed by 450-Mev proton, spallation of Bi^{209} is studied. Recoil characteristics of fission fragments from 450-Mev proton fission of Cu are examined. Studies of collective effects in nucleon reactions on nuclei are outlined. Extra-nuclear cascades are investigated, by studying the spatial distributions of radionuclides formed during the high-energy proton bombardment of a thick target. Operation of the University of Chicago synchrocyclotron is outlined. (T.F.H.)

8761 (TID-14850) PHOTODISSOCIATION OF NUCLEI BETWEEN THE PHOTON ENERGIES OF 1.16 BEV AND 1.35 BEV (thesis). Alfred Don McInturff (California Inst. of Tech., Pasadena and Vanderbilt Univ., Nashville. Graduate School). May 1960. 44p.

An electron-sensitive nuclear emulsion was exposed directly to a bremsstrahlung beam. The stars produced by the beam in the plate were counted to determine the photodissociation yield. The yields were determined for stars of a certain number of tracks and for energies of 1.16, 1.29, and 1.35 Bev. The photon source for the photodissociation events was a thin-target bremsstrahlung beam from an electron accelerator. By recording whether a track was in the direction of or opposite to the glass backing it was possible to make rough determinations of the angular distribution of momentum of the stars' tracks. The multiprong star yield increased rapidly at the mesonic production threshold of 140 Mev. The first indication that the curve was leveling off was found in data. This leveling off began at around 1.2 Bev. (M.C.G.)

8762 (TID-14851) EFFECTS OF INTENSE X-RAYS AND GAMMA-RAYS ON CHLORINE SUBSTITUTED ETHYLENES (thesis). Larry A. Franks (Vanderbilt Univ., Nashville. Graduate School). May 1960. 58p.

The following chlorinated ethylenes were subjected to ionizing radiation of both high and low energies: cis and trans-dichloroethylene, trichloroethylene, and tetrachloroethylene. The products of the irradiations were studied both by gas chromatography and infrared spectroscopy. The G values ranged from 16 to 34.2 compared with 28.7 for ethylene. Polymerization was the dominant reaction in all cases. (M.C.G.)

8763 (CEA-tr-X-425) PREPARATION DU ^{99}Mo, DU ^{116m}In ET DU ^{185}W D'ACTIVITE SPECIFIQUE ELEVEE. (Preparation of Mo^{99}, In^{116m}, and W^{185} of High Specific Activity). H. Ebihara and K. Yoshikara. Translated into French from Bunseki Kagaku, 10: No. 1, 48-53(1961). 17p.

The Szilard-Chalmers reaction in the 8-hydroxyquinolinates of Mo, In, and W is used to enrich the respective Mo^{99}, In^{116m}, and W^{185} contents of these metals by factors of 10 to 130, 10^4 to 10^6, and 430 respectively. The dehydrated 8-hydroxyquinolinates are irradiated in a reactor, then shaken with Michaelis' buffer solutions of various pH values. From the comparative radioactivities of the aqueous and organic phases, the extractabilities and enrichment factors are determined. The Mo must be separated from its daughter Tc by ion exchange. (T.F.H.)

8764 (JPRS-11452) SECOND ALL-UNION CONFERENCE ON RADIATION CHEMISTRY. N. Ya. Chernyak. Translated from Neftekhimiya, 1: 121-3(1961). 5p.

A survey is included of the papers presented at the radiation chemistry conference. The Conference demonstrated an increase in research and the number of institutions participating in this field. The papers are summarized in terms of radiolysis of hydrocarbons, radiation processes in organic systems, radiation polymerization, and radiation effects on polymers. (B.O.G.)

8765 LABORATORY PRODUCTION OF SHORT LIVED RADIOISOTOPES. A. E. Caswell (Dresser Industries, Inc., Tulsa, Okla.). Am. J. Roentgenol., Radium Therapy Nuclear Med., 87: 183-4(Jan. 1962).

A technique for producing short-lived radioisotopes in the laboratory is demonstrated with a Picker-Dresser Type 2920 neutron generator as the neutron source. The production of Na^{24} (half life 15 hours) is described. The technique makes tracer amounts of short-lived isotopes immediately available without the usual wait for delivery from isotope suppliers, and also provides a means of obtaining many isotopes not available commercially due to their short half lives. (P.C.H.)

8766 INTERACTION OF SULFUR AND NATURAL RUBBER BY THE ACTION OF IONIZING RADIATION.

Z. N. Tarasova, M. Ya. Kaplunov, T. V. Kozlov, N. A. Klauzen, and B. A. Dogadkin (Inst. of Rubber Industry, Moscow). Chem. průmysl, 11: 601-4(1961). (In Czech)

The effect of sulfur on the kinetics of the radiation structuration of natural rubber and the properties of the radiation vulcanizates were investigated. At 25°C a marked addition of sulfur under the action of the radiation was observed, the amount increased with increasing dose in conformity with a curvilinear relationship. The rate of addition increased with the temperature. The presence of sulfur diminished the effect of structuration. Increase in temperature during the irradiation from −80 to 100°C caused an intensification in the structuration. With pure rubber at temperatures above 50°C reversion of the structuration process took place; in the presence of sulfur this phenomenon was not observed. On irradiating natural rubber and its mixtures with sulfur in argon a significant fall in unsaturation was observed, the fall being less marked in the presence of sulfur. (auth)

8767 INTRAMOLECULAR ENERGY TRANSFER DURING THE RADIOLYSIS OF ALKYLBENZENES. Kh. S. Bagdasar'yan, N. S. Izrailevich, and V. A. Krongauz (Karpov Physico-Chemistry Inst., USSR). Doklady Akad. Nauk S.S.S.R., 141: 887-90(Dec. 1, 1961). (In Russian)

Intramolecular energy transfers during irradiation are frequently masked by collisions with other excited radicals, especially in polymeric systems. Comparative data on the yields of primary radicals during the radiolysis of alkylbenzenes and of mixtures of benzene and the corresponding alkanes can shed light on the mechanism of intramolecular energy transfer, since the radiation stability of aromatic compounds is greater than that of aliphatic compounds. Purified fractions of benzene, toluene, ethylbenzene, isopropylbenzene, butylbenzene, octylbenzene, octane plus benzene, hexane and octane were subjected to Co^{60} gamma irradiation, and the radical yields were determined by using iodine as a radical acceptor. The experimental G value was found to be significantly lower than the calculated additive value for all the alkylbenzenes, especially for octylbenzene. It can be concluded that the intramolecular transfer of energy in octylbenzene is more effective than the transfer of energy from the aliphatic group of one octylbenzene molecule to the phenyl group of another octylbenzene molecule. By assuming values of 1 and 0.5 for the ratio of the yields of excited alkyl groups to excited phenyl groups, a_A/A_{Ph}, values of 12.5 and 7.1 were calculated for θ, where $\theta = (k_m + k_{APh}[Ph])/(k_{\dot{A}} + k_A)$. The term k_m is the reaction rate for the intramolecular transfer of energy from the aliphatic group to the phenyl group; k_{APh} is the reaction rate for the intermolecular transfer of energy from the aliphatic group of one molecule to the phenyl group of another molecule; Ph is the concentration of phenyl groups; $k_{\dot{A}}$ and k_A are the reaction rates for the formation and destruction of the alkyl groups. Thus, the probability for the intramolecular transfer of energy is much greater than the intermolecular transfer of energy in octylbenzene. (TTT)

8768 THE EFFECT OF EXTERNAL IRRADIATION ON THE SORPTION PROPERTIES OF $BaSO_4$. V. V. Gromov and Vikt I. Spitsyn (Inst. Physical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 141: 891-3(Dec. 1, 1961). (In Russian)

Outgassed samples of $BaSO_4$ were irradiated with 800-kev electrons and with 1.5-Mev protons in an atmosphere of nitrogen. The change in degree of absorption of acid orange and of methylene blue was determined as a function of total dose from 1.3×10^{21} to 1.3×10^{24} ev/g, and as a function of dose strength from 1.3×10^{19} to 1.3×10^{20} ev/g-sec. The absorption of dye decreases with increasing total dose. The decrease in absorption capacity is larger for the same total dose at the lower rate of irradiation. Thus, at a total dose of 1.3×10^{23} ev/γ the maximum adsorption of acid orange is 300 γ/m^2 at a dose strength of 1.3×10^{20} ev/g-sec, and 235 γ/m^2 at a dose strength of 1.3×10^{19} ev/g-sec. With a total proton dose of 0.4×10^{21} ev/g, the maximum adsorption of acid orange is 250 γ/m^2 at a dose strength of 0.5×10^{19} ev/g-sec. The unirradiated samples showed a maximum adsorption of acid orange of about 380 γ/m^2. The surface area of the $BaSO_4$ samples, as measured by the sorption of nitrogen, did not change on irradiation but remained constant at 7.7 m^2/g. The observed radiation effects are apparently due to a disturbance in the normal, electron density distribution in the substance on irradiation. (TTT)

8769 THE ELECTRON PARAMAGNETIC RESONANCE (EPR) SPECTRUM OF IRRADIATED SOLID BENZENE. V. A. Tolkachev, Yu. N. Molin, I. I. Chkheidze, N. Ya. Buben, and V. V. Voevodskii (Inst. of Chemical Physics, Academy of Sciences, USSR and Inst. of Chemical Kinetics and Combustion, Siberian Branch, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 141: 911-12(Dec. 1, 1961). (In Russian)

Chemical data on the radiolysis of liquid benzene and EPR data on the irradiation of solid benzene indicate the formation of the two radicals $C_6H_5^*$ and $C_6H_7^*$. A fine structure of $3 \times 4 = 12$ components in the EPR spectrum can be ascribed to the $C_6H_7^*$ radical, if it is assumed that the unpaired electron is localized principally at the 2, 4, and 6 positions of the ring and that the two hydrogens of the $-CH_2$ group give a triplet with a total splitting of ~90 oersteds. The hydrogen atoms at the 2, 4, and 6 positions each have a splitting of about 10 oersteds width. On slowly heating up a frozen irradiated sample of benzene from 149 to 220°K, additional splitting of the quadrupole line into a triplet with a total width of ~7 oersteds was observed. This evidence indicates that the superfine structure belongs to the $C_6H_7^*$ radical. (TTT)

8770 TITANIUM AND TIN TETRACHLORIDE AS RADICAL ACCEPTORS IN THE RADIOLYSIS OF HYDROCARBONS. V. F. Evdokimov, I. Ya. Poddubnyi, and I. A. Kuzin (Lebedev Synthetic Rubber Scientific Research Inst., USSR). Doklady Akad. Nauk S.S.S.R., 141: 1097-1100 (Dec. 11, 1961). (In Russian)

Mixtures of $TiCl_4$ and n-octane, $TiCl_4$-benzene, $SnCl_4$ and n-octane, and $SnCl_4$-octamethylsiloxane were subjected to irradiation from a Co^{60} source. The radiation yield as determined by the decrease in $TiCl_4$ was lower by a factor of 10 (G = 0.75) as compared with the irradiation of the octane solution. The intermediate reduction product was found to be $TiCl_3$ as determined by chemical analysis. The presence of Ti^{3+} in a mixture of $TiCl_4$ and n-octane irradiated at 77°K was also detected by electron paramagnetic resonance. $SnCl_2$ precipitates on irradiating a mixture of $SnCl_4$ and a hydrocarbon. Irradiation of a mixture of $SnCl_4$ and octamethylcyclotetrasiloxane leads to polymerization and chlorination of octamethylcyclotetrasiloxane. The chlorine content in the polymer is 3 mol. % at a dose of about 30 million r. An increase in the molecular weight of the polymer is observed with increasing concentration of $SnCl_4$. The ratio of methane to hydrogen is constant in irradiating the monomer alone, but increases significantly on the addition of $SnCl_4$ to the monomer. Hence, it can be inferred that the hydrogen atom is more effective than the

methyl radical in reducing $SnCl_4$ under radiation conditions. (TTT)

8771 STABILIZATION OF FREE RADICALS IN A CRYSTALLINE MATRIX. Yu. M. Boyarchuk and N. Ya. Buben (Inst. Chemical Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 141: 1120-3(Dec. 11, 1961). (In Russian)

Samples of the type ($MgCl_2 \cdot 6ROH$ and $CaCl_2 \cdot 4ROH$ where R stands for the methyl, ethyl or n-propyl group) were irradiated with 1.6-Mev electrons at −170°C with a dose of about 40 million rads. Ordinarily, radicals frozen into a solid by irradiation are rapidly destroyed as the melting point of the solid is approached. However, methyl alcohol radicals in a matrix of $MgCl_2$ (irradiated as $MgCl_2 \cdot 6CH_3OH$) are observed at a temperature of −30°C which is significantly above the melting point of CH_3OH. A study of the electron paramagnetic resonance spectrum of the CH_2OH radical shows that there is an increase in amplitude of the central component of the fine structure which is associated with the rotation of the CH_2 − group around the R-C = bond at higher temperatures. Hence, the internal rotation of the CH_2-group can be observed in these radicals. A quintuplet spectrum is observed in the CH_3CHOH radical in which the hydrogen atoms in the α and β positions are equivalent. Five principal lines with an intensity distribution of 1 : 2 : 2 : 2 : 1 are observed in the propyl radical at −150°C. A reversible transition of this quintuplet to a quartet with an intensity distribution of 1 : 3 : 3 : 1 is observed at −90°C due to the change in internal rotation of the CH_2-group at the higher temperature. (TTT)

8772 THE EFFECT OF VARIOUS TYPES OF RADIATION ON THE CATALYTIC DEHYDRATION OF N-DECYL ALCOHOL. Vikt. I. Spitsyn, Ion Maksim, G. N. Pirogova, I. E. Mikhailenko, and P. N. Kodochigov (Inst. of Physical Chemistry, Academy of Sciences, USSR and Inst. of Atomic Physics, Rumanian Peoples Republic). Doklady Akad. Nauk S.S.S.R., 141: 1143-6(Dec. 11, 1961). (In Russian)

Samples of Al_2O_3 catalyst were subjected to three types of radiation: (1) external irradiation of the catalyst and decyl alcohol with 760-kev electrons with a dose of about 10^{20} ev/gram, (2) incorporatin of the beta-emitter Ce^{144} into the catalyst (specific activity of 11.2 mc/g) and (3) irradiation of the Al_2O_3 catalyst with slow neutrons at a flux of $\sim 0.8 \times 10^{13}$ cm^{-2} sec^{-1}. The largest effect was observed on irradiating the catalyst and n-decyl alcohol vapors with fast electrons from an external source. The Al_2O_3 samples treated with Ce^{144} showed a slight increase in catalytic activity. There was a decrease in catalytic activity with the neutron-irradiated Al_2O_3 samples. However, the catalytic activity increased slightly after a 10 day neutron irradiation. (TTT)

8773 POST EFFECTS IN AIR-SATURATED SULFURIC ACID SOLUTIONS CONTAINING FERROUS SULFATE AND ETHYL ALCOHOL ON IRRADIATION WITH PULSED ELECTRONS. L. E. Stolyarchik and A. K. Pikaev (Inst. of Physical Chemistry, Academy of Sciences, USSR and Inst. of Nuclear Research, Polish Academy of Sciences, [Warsaw]). Doklady Akad. Nauk S.S.S.R., 141: 1147-50(Dec. 11, 1961). (In Russian)

Sulfuric acid solutions containing $FeSO_4$ and ethyl alcohol, and saturated with air were given a dose of 1 to 2×10^{18} ev per pulse of 0.8-Mev electrons. The changes in the concentrations of Fe^{3+} with time were followed spectrometrically. On irradiating a 0.4 M H_2SO_4 solution containing a constant concentration of Fe^{2+} (2.5×10^{-4} M) and a variable concentration of ethyl alcohol (10^{-4} to 10^{-1} M) it was found that the final values of $G(Fe^{3+})$ increased with increasing alcohol concentration. The post-radiation effect (increasing G value of Fe^{3+}) lasted from a few minutes to about an hour. No increase in $G(Fe^{3+})$ or post radiation effect was observed if oxygen was displaced from the solution by argon before irradiation. With a variable Fe^{2+} concentration (2.5×10^{-4} M Fe^{2+} to 2.5×10^{-3} M Fe^{2+} and a constant concentration of ethyl alcohol (10^{-2} M), the final value of $G(Fe^{3+})$ increases with increasing concentration of Fe^{2+}. The increase in $G(Fe^{3+})$ is almost proportional to the concentration of C_2H_5OH at low concentrations of ethyl alcohol. The value of $G(Fe^{3+})$ is a factor of two greater in a solution containing $>10^{-3}$ M C_2H_5OH and $<5 \times 10^{-4}$ M Fe^{2+} than it is in a solution containing no alcohol. The addition of H_2O_2 accelerates the oxidation of Fe^{2+} in the presence of C_2H_5OH. The radical reactions are listed for the mechanism of the process. (TTT)

8774 THE RADIOLYSIS OF N-HEXANE AT LOW INTEGRAL DOSE (3×10^{18} TO 1×10^{20} ev ml). V. G. Berezkin, A. E. Mysak, and L. S. Polak. Doklady Akad. Nauk S.S.S.R., 141: 1397-9(Dec. 21, 1961). (In Russian)

Hexane samples were irradiated from a Co^{60} source at a small integral dose of 3 to 100×10^{18} ev/ml at a constant dose rate of 6.6×10^{14} ev/ml-sec. The gaseous radiolytic products (methane, ethane, ethylene, propane, propylene, butane, and butene-1) were determined by gaseous chromatography. The data were found to fit the relationship: $\lg P = \lg k + \lg D$, that is, $P = k D^a$, where P is the yield of gaseous product and D is the dose. It was found that $a(c_1$ to $c_4) = 0.92$, $a(c_2$ to c_4−the alkanes) = 0.92 and $a(c_2$ to c_4−the alkenes) = 0.88. The difference in yields can be explained by hydrogenation of unsaturated compounds. The G yields (mols/100 ev) for the gaseous hydrolytic products were found to be 0.41 for methane, 0.82 for ethane, 0.62 for ethylene, 0.68 for propane, 0.31 for propylene, 0.65 for butane, and 0.24 for butene-1. (TTT)

8775 INITIATION OF PEROXIDATION OF KEROSENE BY IONIZING RADIATION. M. Klang and A. Drăgut. Intern. Chem. Eng., 2: No. 1, 68-73(Jan. 1962). (In English)

The influence of initiators (gamma rays and peroxidized product recycled from a previous batch) on the peroxidation of kerosene was investigated. It was established that initiation of the peroxidation of kerosene by means of gamma rays is just as effective as when benzoyl peroxide is used as initiator. The use as initiator of peroxidized product taken from a previous batch, which has a peroxide index equal to or greater than 5 mg 0/g material, and which is used in an amount equal to 3-5% of the material to be peroxidized, gives results at least equal to those obtained with the other two initiators (gamma rays or benzoyl peroxide). The influence of the catalysts: sodium stearate, formate, and carbonate on the peroxidation reaction was compared to the uncatalyzed reaction (with only the peroxidized product used as initiator in the amount of 5% referred to the raw material). With the exception of ammonia, all the catalysts investigated increased the reaction rate; sodium formate and stearate also caused a slight increase in the yield of peroxides compared to the uncatalyzed process. Sodium carbonate gave a lower yield of peroxides compared to sodium formate or stearate. The influence of the degree of refining on the peroxidation reaction was investigated. For peroxide indices of 7.5-8.4 mg 0/g material, that is, approximately 5.5-6.0% peroxide content in the peroxidized material, a maximum of 6.5% alkylaromatics content is admissible. Based on existing

literature data, the dependence of the reaction duration and of the peroxide yield on the operating temperature was established. (auth)

8776 RADIATION-THERMAL CRACKING OF GAS OIL. G. M. Panchenkov, V. I. Yakovlev, L. L. Kozlov, G. I. Zuravlev, V. A. Gol'din, and Yu. S. Ryabukhin. Izvest. Vysshikh Ucheb. Zavedenii, Neft i Gaz, No. 12, 99-101(1961).

The radiation-thermal cracking of Romashkino gas oil fraction with a boiling range of 300 to 345°C was studied. The specimens were irradiated at 400 and 425°C by Co^{60} γ rays at a dose rate of 100 r/sec with the use of K-18000 equipment. The decomposition rate of the initial gas oil with irradiation was found to be twice that for thermal cracking alone under similar conditions. For a dose of 5 Mr the yield of the fraction boiling at 200°C reached 30 to 35% of the initial raw material, as compared with 20% in the case of thermal cracking. The olefine content of the fraction boiling at 200°C obtained by radiation-thermal cracking was lower than that of the fraction obtained by thermal cracking only. (OTS)

8777 ELECTRON SPIN RESONANCE STUDY OF IRRADIATED METHANOL. Patricia J. Sullivan and W. S. Koski (Johns Hopkins Univ., Baltimore). J. Am. Chem. Soc., 84: 1-4(Jan. 5, 1962).

The electron spin resonance spectra of ultraviolet irradiated isotopically substituted methanol were investigated. Studying the spectra as a function of isotopic substitution, time of irradiation, and temperature permitted the identification with considerable certainty of these radicals, $\cdot CH_2OH$, $\cdot CH_2OD$, $\cdot CH_3$, $\cdot CD_3$, $\cdot CHO$, and $\cdot CDO$. Evidence also was obtained for the radicals $\cdot CD_2OH$, $\cdot COD$, $\cdot COH$, $CH_3O\cdot$, and $CD_3O\cdot$. (auth)

8778 γ-RADIATION-INITIATED POLYETHENESULFONAMIDE. Richard H. Wiley and F. B. Alvey (Univ. of Louisville, Ky.). J. Polymer Sci., 56: 11-18(Jan. 1962). (In English)

The rate of the radiation-initiated polymerization of ethenesulfonamide, which is relatively high (1.25%/min.), was found to be dependent on the 0.96 power of the intensity of the radiation. At increasing radiation dose levels the viscosity decreased and then remained constant indicating a balance between radioinduced degradation and branching. The polyelectrolyte character of the polymer is shown in both viscosity and light-scattering data. (auth)

8779 ELECTRON SPIN RESONANCE STUDY OF IRRADIATED POLYPROPYLEN. H. Fischer and K.-H. Hellwege (Deutsches Kunststoff-Institut, Darmstadt, Ger.). J. Polymer Sci., 56: 33-45(Jan. 1962). (In German)

Rather exact results were obtained about the structure of the macroradicals formed by irradiation by the investigation of the anisotropy of the electron spin resonance spectra of stretched isotactic polypropylene. On irradiation at 77°K radicals of the structure

$$-CH_2-\underset{\displaystyle CH_3}{CH}-CH_2-\underset{\displaystyle CH_3}{C}-CH_2-\underset{\displaystyle CH_3}{CH}-$$

were found to be formed to a dominating extent. At room temperature, on the other hand, radicals, presumably of the allyl type

$$-CH_2-\underset{\displaystyle CH_3}{CH}-CH=\underset{\displaystyle CH_3}{C}-CH-\underset{\displaystyle CH_3}{CH}-$$

were quite persistent. (auth)

8780 KINETICS OF MUTUAL RADIATION GRAFTING OF STYRENE IN ETHYL CELLULOSE FILM. Richard A. Mock and William N. Vanderkooi (Dow Chemical Co., Midland, Mich.). J. Polymer Sci., 56: 69-81(Jan. 1962). (In English)

A general procedure is described by means of which the $k_p/k_t^{1/2}$ ratio can be determined for the graft polymerization of vinyl monomers in an organic substrate. The method takes rigorous account of the influence of monomer diffusion on the reaction kinetics. As an experimental example, the mutual radiation grafting of styrene onto ethyl cellulose film by use of 2-Mev Van de Graaff electrons to initiate free radical formation is described in detail. (auth)

8781 EFFECT OF GASES ON THE ELECTRON SPIN RESONANCE SPECTRA OF IRRADIATED ACRYLAMIDE AND METHACRYLAMIDE. Hisashi Ueda, Zen'ichiro Kuri, and Shoji Shida (Japanese Assn. for Radiation Research on Polymers, Tokyo). J. Polymer Sci., 56: 251-6(Jan. 1962). (In English)

The effects of various gases on irradiated acrylamide and methacrylamide were studied by ESR. The results are not the same with irradiated monomers and irradiated polymers. Nitrogen oxide and hydrogen sulfide are known as radical scavenger, but they act as radical transformers for these samples. In source and postirradiation reaction of polyacrylamide or polymethacrylamide with hydrogen sulfide give rise to broad spectra having a g factor of 2.0267 and the new radicals produced are concluded to be of the $RS^{\bullet}$ type. (auth)

8782 IRRADIATION VULCANIZATES OF METHYLVINYLSILOXANE RUBBER WITH IMPROVED THERMAL STABILITY. S. V. Aver'yanov, I. Ya. Poddubnyi, Yu. V. Trenke, and L. A. Aver'yanova. Kauchuk i Rezina, No. 12, 1-7(Dec. 1961).

Irradiation vulcanizates of methylvinylsiloxane rubber containing 0.07 mol % vinyl groups (MUS-0.07) were found to have a higher thermal stability than irradiation vulcanizates of dimethylsiloxane rubber. The higher thermal stability is explained by the presence of the cross links $\rightarrow Si-CH_2-CH_2-CH_2-Si\leftarrow$ and $\rightarrow Si-CH_2=CH_2-Si\leftarrow$. Addition of multivalent metal compounds promotes the formation of a regular vulcanization network and further increases the thermal stability of the irradiation vulcanizates. Also, multivalent metal compounds prevent degradation and further structuration of the vulcanizates. Irradiation vulcanizates of MUS-0.07 rubber containing various light-colored fillers and multivalent metal compounds were found to exhibit satisfactory physical and mechanical properties after long-time aging (10 to 55 days) at 300 to 330°C and short-time aging (2 to 4 hr) at 370 to 380°C. Still higher thermal stability of MUS rubber vulcanizates can be achieved by conducting the irradiation in vacuum or by introducing a halogenated polymer into the rubber mix. In the first case the rise in stability results from the absence of weak oxygen-containing cross links; the irradiation dose can be reduced from 7.4 to 4.3 mr. Introduction of a halogenated polymer into the rubber mix promotes the formation of strong new cross links or grafted chains which increase the molecular interaction in the system; vulcanizates of MUS rubber mixes whose formulas contain a halogenated polymer, a compound of a multivalent metal, and aerosil as the filler retain satisfactory strength and elasticity after short-time aging at 400°C. MUS-0.07 irradiation vulcanizates have considerably higher heat resistance and thermal stability than peroxide vulcanizates in a closed system at 200 to 250°C under high pressure. They exhibit a lower value of residual deformation after compression at 150 to 250°C and have a somewhat higher low-temperature resistance. (OTS)

8783 RADIATION-INDUCED RADICALS IN WATER, DEUTERIUM OXIDE AND AQUEOUS SOLUTIONS OF GLYCINE AT LOW TEMPERATURES. Thormod Henriksen (Norwegian Radium Hospital, Oslo). Nature, 193: 371-2 (Jan. 27, 1962).

The electron spin resonance centers induced in irradiated water and deuterium oxide were examined, and the stabilization of OH and OD radicals at liquid nitrogen temperature was confirmed. Samples of water, deuterium oxide, and a 1 M glycine solution were frozen and exposed to 220-kv x rays at 77°K. The electron spin resonance of irradiated water shows a doublet with a broad superimposed resonance. In deuterium oxide a triplet is observed instead of the doublet, and the broad resonance is also somewhat altered. The doublet has a splitting of 41.5 gauss compared with the triplet splitting of 6.5 gauss. When a frozen sample is gradually warmed, the radioinduced electron spin resonance centers diffuse and take part in secondary reactions. Thus, when the glycine solution was annealed at 193°K for 15 sec the water resonance was quenched, and the resonance of the glycine solution then consisted of a triplet with some other resonance superimposed. On further annealing at 193°K, the latter disappeared, whereas the triplet was stable nearly up to the melting point of the solution. (P.C.H.)

8784 HYDRAZINE FROM A CHEMONUCLEAR REACTOR. D. A. Landsman (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Eng., 7: 50-2(Feb. 1962).

The production of hydrazine by the irradiation of liquid ammonia in a chemonuclear reactor is described. The process is shown to be economically feasible and the production rate from such a process is known to be an improvement over the present processes, however the design problems of such a reactor at this stage prevent the process from being realized. The problems encountered in developing such a reactor are presented and discussed. (N.W.R.)

8785 RAPID CARRIER FREE SEPARATION TECHNIQUE. W. C. Parker and Y. Grunditz (Univ. of Uppsala). Nuclear Instr. & Methods, 14: 71-5(Nov. 1961). (In English)

Apparatus and techniques are described for the rapid carrier-free separation of radioactive nuclides not isotopic with the target material. The principle employed, that of fractionation by volatilization at reduced pressures, was developed to a reasonable degree of efficiency in so much that comparable yields with those chemical techniques normally employed were obtained. Added advantages are that a far shorter period of time is required for the separation; contamination of the sample, from foreign material, is reduced to a minimum; and finally, both the separation and deposition are achieved in a single operation. (auth)

8786 RADIOASSAY OF LABELLED ORGANIC COMPOUNDS USING GASEOUS SAMPLES. II. CARBON-14 ASSAY BY MEANS OF CARBON DIOXIDE COUNTING IN THE GEIGER AND THE PROPORTIONAL REGION. Ryōichi Itō, Tadashi Nozaki, Asao Nakamura, Naotake Morikawa, and Osamu Simamura (Tokyo Univ.). Radioisotopes (Tokyo), 10: 297-301(Sept. 1961). (In Japanese)

Internal gas counting techniques are studied for measuring low-activity carbon-14 in organic substances. The carbon-14 is analyzed by means of carbon dioxide counting in the Geiger-Mueller and proportional region. The characteristics of a proportional counter tube filled with a mixture of carbon dioxide and propane at 1 atm are described. It is shown that the introduction of air up to 1 cm Hg into the counting gas mixture causes a shift of the plateau by about 100 volts towards the higher voltage region without changing the tube performance. Thus, propane is concluded to be superior as a filling gas to PR gas in that much larger quantities of carbon dioxide can be used and that contamination with air has no appreciable effect. The characteristics of a Geiger-Mueller tube filled with a mixture of carbon dioxide and Q gas at 1 atm are also described. Results show that the plateau voltage is markedly higher and the plateau length is shorter with increased partial pressure of carbon dioxide. The resolving time is 160 μsec. A trace of air in a counting gas mixture shows serious injurious effects. (N.W.R.)

8787 RADIOASSAY OF LABELLED ORGANIC COMPOUNDS USING GASEOUS SAMPLES. III. CONVERSION OF TRITIATED WATER INTO BUTANE-1-^{3}H AND ITS GAS-COUNTING. Ryōichi Itō, Tadashi Nozaki, Asao Nakamura, Naotake Morikawa, and Osamu Simamura (Tokyo Univ.). Radioisotopes (Tokyo), 10: 302-9(Sept. 1961). (In Japanese)

Conversion of tritiated water into tritiated butane and radioactivity determination of the latter by Geiger-Mueller gas-counter tube methods are described. The procedure developed is useful for assaying low-activity tritium in labeled organic compounds. The characteristics of a glass Geiger-Mueller counter tube with an evaporated gold cathode and a tungsten wire anode filled with tritiated butane at various pressures are described. The tritiated butane is prepared from tritiated water in an apparatus schematically shown according to the following equation: $2BuMgBr + H_2^3O \rightarrow 2BuH^3 + Mg_2OBr_2$. The solvent is diethyl carbitol and the reaction mixture is gently boiled under a pressure of 5 cm Hg. The reaction is nearly complete in two hours; 85% of the theoretical amount is obtained in less than an hour. The fractionation of tritium due to possible kinetic isotope effect is not noticeable when more than 75% of the theoretical amount is collected. (N.W.R.)

8788 DISTRIBUTION OF RADIOACTIVITY IN RECOIL-LABELLED TOLUENE-^{14}C. R. Visser, C. R. Redvanly, F. L. J. Sixma, and A. P. Wolf (Universiteit, Amsterdam and Brookhaven National Lab., Upton, N. Y.). Rec. trav. chim., 80: 533-6(June 1961). (BNL-5234). (In English)

Toluene-C_1^{14} produced by the thermal neutron irradiation of a mixture of benzene and 2-methylpyrazine is not specifically labelled in the methyl group, ruling out simple hydrogen replacement in benzene by the recoiling carbon-14 for at least some fraction of the radioactive toluene produced. Using a recently published degradation scheme, the distribution of radioactivity in the ring relative to the methyl group was determined. (auth)

8789 THE REACTION OF LOW MOLECULAR WEIGHT ORGANIC COMPOUNDS INITIATED BY COBALT-60 GAMMA-RADIATION. III. POLYMERIZATION OF METHYL METHACRYLATE. EFFECTS OF MONOFUNCTIONAL ADDITIVES. Motome Hamashima. Tokyo Kôgyô Shikensho Hôkoku, 56: 424-31(Oct. 1961). (In Japanese)

Methyl methacrylate was polymerized by gamma irradiation from a 2000 curie cobalt-60 source in the absence or presence of additives over the temperature range from 15 to 29°C in vacuum. In the absence of additives, the molecular weight of the polymer and the rate of the polymerization reaction depend largely on the reaction temperature. The over-all heat of polymerization is found to be 2.9 kcal/mole. Each of about 70 kinds of additives was added to the monomer so that the concentration of the former was 0.1 mole/l. A large effect was observed on the acceleration efficiency, R_E, the product of R_P and R_M, where R_P is the

ratio of the polymerization rates and R_M is that of viscosity average molecular weights of the polymers produced with and without the use of an additive under the same experimental conditions. The value of R_E remains almost constant irrespective of the additives so far as they possess the same functional groups, and is independent of the change of reaction temperature. The value of R_E decreases in the following order of additives: hydroxy compounds > ethers > acids and their anhydrides > hydrocarbons > esters > halogenated compounds > amines > ketones > nitro compounds. (auth)

8790 THE REACTION OF LOW MOLECULAR WEIGHT ORGANIC COMPOUNDS INITIATED BY COBALT-60 GAMMA-RADIATION. IV. POLYMERIZATION OF METHYL METHACRYLATE. EFFECTS OF MONO- AND DI-FUNCTIONAL ADDITIVES. Motome Hamashima. Tokyo Kôgyô Shikensho Hôkoku, 56: 432-8(Oct. 1961). (In Japanese)

Methyl methacrylate was polymerized by gamma irradiation from a 2000-curie Co^{60} source in the absence or presence of additives in the temperature range from 20 to 30°C in vacuum. The value of $R_E(R_E = R_P \times R_M)$ changes with the kind of additive when the latter has two kinds of functional groups in the molecule and its concentration is 0.1 mole/l. The values of R_P and R_M, and hence R_E, depend on the concentration of the additive, when the additive has only one kind of functional group in the molecule and its concentration range is from 0.02 to 0.2 mole/l. The values of chain transfer constant of the additives were also calculated. (auth)

8791 THE REACTION OF LOW MOLECULAR WEIGHT ORGANIC COMPOUNDS INITIATED BY COBALT-60 GAMMA-RADIATION. V. POLYMERIZATION OF VINYL ACETATE. EFFECTS OF MONO-FUNCTIONAL ADDITIVES. Motome Hamashima. Tokyo Kôgyô Shikensho Hôkoku, 56: 439-47(Oct. 1961). (In Japanese)

Vinyl acetate was polymerized by gamma irradiation from a 2000-curie cobalt-60 source in the absence or presence of additives in the temperature range from 20 to 30°C in vacuum. In the absence of additives, the rate of polymerization and the molecular weight of the polymer depend largely on the reaction temperature. The over-all heat of polymerization is found to be 2.0 kcal/mole. About 70 kinds of additives were examined at the concentration of 0.1 mole/l, as the effect of the additive was remarkable even at low concentration. Acceleration efficiency, $R_E(R_E = R_P \times R_M$, where R_P is the ratio of the polymerization rates and R_M is that of viscosity average molecular weights of the polymers produced with and without the use of an additive under the same experimental conditions), remains constant so long as the additives possess the same functional groups, and is independent of the change of reaction temperature. The value of R_E decreases in the following order: acids and their anhydrides > hydroxy compounds > esters > hydrocarbons > ethers > ketones > halogenated compounds > amines > nitro compounds. (auth)

8792 THE REACTION OF LOW MOLECULAR WEIGHT ORGANIC COMPOUNDS INITIATED BY COBALT-60 GAMMA-RADIATION. VI. POLYMERIZATION OF VINYL ACETATE. EFFECTS OF MONO- AND DI-FUNCTIONAL ADDITIVES. Motome Hamashima. Tokyo Kôgyô Shikensho Hôkoku, 56: 448-54(Oct. 1961). (In Japanese)

Vinyl acetate was polymerized by gamma irradiation from a 2000-curie Co^{60} source in the absence or presence of additives in the temperature range from 20 to 30°C in vacuum. The value of $R_E(R_E = R_P \times R_M)$ was found to change when additives with two kinds of functional groups in the molecule are added to the monomer at the concentration of 0.1 mole/l. The values of R_P and R_M, and hence R_E, depend on the concentration of the additive when there is only one functional group in the molecule and its concentration range is from 0.02 to 0.1 mole/l. The values of chain transfer constants of the additives were also calculated. (auth)

8793 ZÀKLADY JADERNÉ CHEMIE. (Fundamentals of Nuclear Chemistry). Vladimír Majer. Prague, State Publishing House for Technical Literature, 1961. 607p.

A book is presented intended for use as a textbook in colleges and as a reference work for research workers. The history of the discovery of radioactivity is discussed first followed by description of the laws of radioactive decay, radioactive and stable isotopes, nuclear structure, atomic models and an outline of nuclear chemistry and radiochemistry. In another chapter nuclear reactions are discussed in detail, including artificial radioactivity, nuclear isomerism, reaction kinetics and energetics and nuclear levels. The mechanism of the (n,γ) and of the Szilard-Chalmers and other reactions are discussed in detail. This is followed by a description of the chemical effects of the interaction of radiation with matter, laying the foundation of radiation chemistry. The chemistry of the radioactive elements and of the actinides is treated separately. After reviewing the isotopic methods, the operational methods of nuclear chemistry are described. Preparation of artificial elements by means of cyclotron, betatron, synchrotron and linear accelerator is presented together with the principles of activation analysis. The various applications of analytical techniques such as tracer methods and the instrumentation needed for detection are mentioned in detail. Reactor technology together with description of the materials needed is considered in detail. A special chapter is devoted to the review of the status of controlled thermonuclear reactions. (TTT)

8794 RADIOISOTOPE CATALOGUE. (Israel. Atomic Energy Commission, Rehovoth). Oct. 1961. 39p.

A review is presented of the irradiation methods, ordering and transportation procedures, isotopic compositions, chemical purities, activities, and prices of radioisotopes produced in the Israel Research Reactor (IRR-1). A listing is given of the short-lived isotopes that are routinely produced. The facilities are also adequate for the production of other long- or short-lived isotopes on request. (T.F.H.)

8795 AN IMPROVED PROCESS FOR THE PRODUCTION OF CROSS-LINKED POLYVINYL CHLORIDE. (to Compagnie de Saint-Gobain). British Patent 887,440. Jan. 17, 1962.

A process is outlined for crosslinking polyvinyl chloride by irradiation without degradation or change in color. The process comprises swelling the polyvinyl chloride by one of the solvents tetrahydrofuran, dioxane, and tetrahydronaphthalene and subjecting the swollen polymer to electrons or neutrons in the presence of air. Thus, a polyvinyl chloride is obtained which has kept its normal appearance and in addition has improved physico-chemical properties. (D.L.C.)

8796 POLYOLEFINE FILM BACKINGS FOR PRESSURE-SENSITIVE ADHESIVE TAPE. Derek Wilfred Aubrey (to Adhesive Tapes Ltd.). British Patent 887,950. Jan. 24, 1962.

A method is given for treating polyethylene and polypropylene films so that they will tear easily and uniformly

for use as backing for pressure-sensitive adhesive tape. The method comprises crosslinking the polymeric films by irradiation with far u-v light (2000 to 3000 A) in the presence of an activator, usually a ketone. (D.L.C.)

8797 HYDROGENATION PROCESS. (to Esso Research and Engineering Corp.). British Patent 888,082. Jan. 24, 1962.

A hydrogenation process is outlined which comprises subjecting a mixture of hydrogen and a gaseous radiation acceptor to ionizing radiation in the presence of a gaseous hydrogen acceptor until a total dose of 0.36 to 12,000 whr/g mixture has been received. In this process, the radiation acceptor catalyzes the conversion of molecular hydrogen into atomic hydrogen, which then reacts with the hydrogen acceptor. The radiation acceptor may be one of the rare gases, nitrogen, carbon monoxide, or mixtures thereof, and the hydrogen acceptor may be an organic or inorganic compound. Examples of the process are given in which ethylene, 1,3-butadiene, and benzene are hydrogenated. (D.L.C.)

8798 POLYMERS OF 3,3,3-TRICHLOROPROPENE. (to Dow Corning Corp.). British Patent 888,730. Feb. 7, 1962.

A process is given for producing homopolymers of high melting point (>150°C) and suitable for structural uses from 3,3,3-trichloropropene. The process comprises subjecting 3,3,3-trichloropropene to electromagnetic radiation at a temperature below 80°C, preferably u-v light below 35°C. The polymer units are combined with each other in the 1,3 relationship. (D.L.C.)

8799 PRODUCTION OF POLYFORMALDEHYDE. (to Houilleres du Bassin du Nord et du Pas-de-Calais). British Patent 889,170. Feb. 7, 1962.

A process is given for irradiating formaldehyde to produce polymers thereof without danger of explosion. The process comprises carrying out the monomer irradiation at −196 to −160°C in the presence of a moderating agent to reduce the extent of heat liberation when the reaction mass is heated to temperatures above −160°C. The moderating agent may be an inert, nonpolymerizable diluent or polyformaldehyde itself. (D.L.C.)

Raw Materials and Feed Materials

8800 (NP-tr-849) PHYSICAL TREATMENT OF URANIUM-BEARING ORES. E. Roques. Translated by F. Hudswell (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Rev. ind. minérale, 42: 542-51(1960). 25p.

Original also issued as CEA-1635.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 4045.

8801 HYDROMETALLURGICAL PRODUCTION OF URANIUM DIOXIDE FOR REACTOR FUEL ELEMENTS. I. H. Warren and F. A. Forward (Univ. of British Columbia, Vancouver). Can. Mining Met. Bull., 54: 743-9(Oct. 1961).

The reduction of aqueous slurries of uranyl carbonate at elevated temperature with compressed hydrogen in the presence of metal catalysts and certain organic promoters is shown to yield uranium dioxide. The reduction takes place in a sequence of steps. The purity and sintering properties of the dioxide make it of interest as a starting material for fuel element production. Simple control can be exercised over the surface area and oxygen/uranium ratio of the product during reduction. (auth)

Separation Processes

Refer also to abstract 8832

8802 (BM-RI-5910) EXTRACTION AND SEPARATION OF YTTRIUM AND RARE-EARTH ELEMENTS FOUND IN EUXENITE. William G. Gruzensky (Bureau of Mines. Albany Metallurgy Research Center). Apr. 1960. 26p.

Studies relative to the separation of yttrium and the individual rare-earth elements (lanthanons) from mixtures in which they occur was undertaken at the Federal Bureau of Mines Albany Metallurgy Research Center and resulted in the development of a solvent extraction method by which yttrium can be separated from the rare-earth metals. A separation factor of 10.93 was obtained between yttrium and cerium from a single-stage extraction, and a factor of 1.78 was obtained between yttrium and erbium from a multistage system. The valuable metals were extracted from euxenite by caustic soda fusion or by chlorination, and several separation methods were investigated. Partial separation of the yttrium and rare-earth element fraction was made by chemical methods and by solvent extraction. Thermal decomposition of aqueous rare-earth nitrates or selective ignition of yttrium and rare-earth oxalates yielded a fraction enriched in cerium. A fraction enriched in the light rare-earth elements resulted from a double sulfate precipitation, whereas a potassium ferrocyanide precipitation yielded a fraction enriched in yttrium. Precipitation with dimethyl phosphate yielded a fraction enriched in yttrium and heavy rare-earth elements. Enriched fractions were obtained with several solvent extraction systems. A system consisting of rare-earth nitrates, nitric acid, and tri-n-butylamine-3 methyl-2-butanone favored the separation of yttrium from the heavy as well as from the light rare-earth elements. (auth)

8803 (BM-RI-5923) AMINES IN LIQUID-LIQUID EXTRACTION OF RARE-EARTH ELEMENTS. A. C. Rice and C. A. Stone (Bureau of Mines. Reno Metallurgical Research Center, Nev.). Apr. 1961. 19p.

The efficiencies of several amines in the liquid-liquid solvent extraction of rare earth and Y solutions are compared. Favorable results are obtained using sulfate solutions, but extraction from chloride, nitrate, and perchlorate solutions is negligible. Distribution coefficients and separation factors are found for rare earths and Y. The most effective separations are obtained with the amines Primene 81-R, Primene JM-T, and N-benzylheptadecylamine. Effects of pH, types of amines and organic diluents used, and amine and rare earth solution concentrations are determined. (T.F.H.)

8804 (HW-69506) DYNAMIC CHARACTERISTICS OF A PULSED CHEMICAL EXTRACTION COLUMN. Glenn R. Taylor (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 8, 1961. Contract AT(45-1)-1350. 17p.

The mechanical properties were evaluated of an air pulsed chemical extraction column, consisting of a column with an associated pulse leg. Air pressure applied to the pulse leg causes a displacement in the fluid in the pulse leg and in the column by an amount proportional to the pulse pressure. Fluid displacements in the pulse leg were measured as functions of applied air pressure, pulse frequency, and specific gravity of the fluid. Representative results are shown graphically. (B.O.G.)

8805 (HW-70998) THE RECOVERY AND PURIFICATION OF MULTI-KILOCURIE QUANTITIES OF FISSION

PRODUCT STRONTIUM BY CATION EXCHANGE. L. A. Bray, L. F. Lust, R. L. Moore, F. P. Roberts, F. M. Smith, H. H. Van Tuyl, and E. J. Wheelwright (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 8, 1961. Contract AT-(45-1)-1350. 35p.

In seven production runs, 75,000 curies of Sr^{90} were isolated and purified in the ion-exchange equipment of Hanford Laboratories High Level Cells. The production goal (60,000 curies of purified Sr^{90}) and the time schedule were met or exceeded and the product exceeded the customer's purity requirements. The hot-cell-purified strontium made possible the completion on time of the Weather Bureau power source and the Martin 10 watt SNAP VII-A and VII-C units. The isotopic purity of the strontium product was 56% Sr^{90}. The chemical purity was greater than 95% strontium. The $Zr-Nb^{95}$ contamination of the product was less than 5×10^{-5} curies per curie of Sr^{90}, and the $Ce-Pr^{144}$ contamination was less than 1×10^{-5} curies per curie of Sr^{90}. The final run yielded 16,500 curies of Sr^{90} in an eight liter product solution. The product was >98% strontium and contained less than one curie of $Zr-Nb^{95}$ or $Ce-Pr^{144}$. Eleven days of continuous operation were required to complete the run. (auth)

8806 (IDO-14555) TECHNICAL PROGRAMS AND PROJECTS AT THE IDAHO CHEMICAL PROCESSING PLANT. J. A. McBride (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 7, 1961. Contract AT(10-1)-205. 51p.

The need of advanced processes for more complex reactor fuels is emphasized. The development of the Electrolytic Dissolution process is described briefly. Possible head-end separation of the bulk alloy constituent of zirconium alloy fuels is discussed, particularly the barium fluozirconate process. The ARCO process is described and its waste production compared with these for other processes for STR-type fuels. The scope and purpose of research on chemistry of fuel processing are outlined. The concept of a small-scale reprocessing plant is discussed. Research on waste processing include conversion to solids, mercury cathode reduction of stainless steel wastes, removal of Cs^{137} and Sr^{90} from wastes by ion exchange, and ultimate fission product disposal. Systems engineering practice is described. An air pulser which is to replace the present remote diaphragm pulser is described. The advantages of a pulsed continuous countercurrent liquid-solid contactor are given. A hot pilot plant for optimizing processes with irradiated fuels and for studying irradiated materials is considered. (D.L.C.)

8807 (IDO-14577) MATERIALS CONTROL TECHNIQUES IN REPROCESSING ENRICHED URANIUM. G. A. Huff and F. H. Tingey (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Dec. 19, 1960. Contract AT(10-1)-205. 54p.

During the reprocessing of nuclear fuel, it is necessary to accurately account for nuclear materials involved. Various aspects of the accounting technique are covered. Process technology including information on nuclear safety control, fuel receipt and storage, flowsheets for aluminum, stainless steel and zirconium dissolution and first cycle extraction, product bottling, and waste handling is discussed. Measurement technology covers measurement of process variables, calibration of instruments and vessels, problems of instrumentation encountered in plant operation, in line instrumentation, sampling, analytical procedures, and quality control. The flow of written records is described together with the paper work involved in accounting procedures. Analytical bias control, sampling error control, auxiliary control techniques, statistical treatment of tank calibration data obtained by the weigh tank method, limits of uncertainty, and decision functions are discussed. (auth)

8808 (MND-P-1972) AMERICIUM-241 AND CURIUM-242 FUEL PROCESSING HAZARDS. (Martin Co. Nuclear Div., Baltimore). Aug. 1959. Contracts AT(30-3)-217 and AF33(616)-5042. 28p.

The processing of Am^{241} preparatory to its encapsulation for irradiation, the extraction of Cm^{242} from the irradiated material, and the subsequent processing of Cm^{242} into suitable fuel forms is described. The radiological hazards involved are discussed. (M.C.G.)

8809 (NAA-SR-269) THE SEPARATION OF URANIUM FROM $NaF-KF-UF_4$ AND $NaF-ZrF_4-UF_4$ WITH BrF_3. F. J. Keneshea, Jr. (North American Aviation, Inc., Downey, Calif.). Aug. 26, 1953. Contract AT-11-1-GEN-8. 22p.

The use of the BrF_3 process in the removal of uranium from the fluoride mixtures $NaF-KF-UF_4$ (47-26-27 mole per cent, respectively) and $NaF-ZrF_4-UF_4$ (50-46-4 mole per cent, respectively) was investigated. More than 99 per cent of the uranium in the $NaF-KF-UF_4$ mixture was removed by direct treatment with liquid BrF_3. Effective separation of the uranium from the $NaF-ZrF_4-UF_4$ mixture required a pretreatment of the salt. Fusion with KF followed by BrF_3 treatment removed 95 per cent of the uranium from this fuel material. Direct treatment of the $NaF-ZrF_4-UF_4$ mixture with BrF_3 removed only 15 per cent of the uranium. Fusion of the zirconium-bearing fuel material with metallic fluorides other than KF, namely, NaF, RbF, and PbF_2 also improved the separation of uranium upon subsequent treatment with BrF_3. The best fluoride for fuel pretreatment was found to be KF. The extent of uranium removal from $NaF-ZrF_4-UF_4$ as a function of the amount of KF used in prefusion showed that a maximum separation of 95 per cent was obtained with a mole ratio of $KF/ZrF_4 = 1$. The uranium removal from $NaF-ZrF_4-UF_4$ was increased to 98.2 per cent by employing a 2 cycle KF fusion-BrF_3 treatment. (auth)

8810 (NAA-SR-6666) SEPARATION OF URANIUM FROM THORIUM BY LIQUID METAL EXTRACTION THORIUM RECOVERY AND FISSION PRODUCT DISTRIBUTION. J. D. Chilton, L. A. Hanson, E. W. Murbach, and F. W. Dodge (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 1, 1962. Contract AT-11-1-GEN-8. 21p.

Additional results were obtained on the small-scale separation of uranium from thorium by molten magnesium extraction. This process is aimed at the separation and recovery of uranium and thorium from a thorium breeder blanket. On dissolution of a thorium–uranium alloy in molten magnesium, 90 to 95% of the uranium introduced was recovered as a uranium–thorium–magnesium concentrate. Precipitation and filtration of thorium hydride from the magnesium solution resulted in recovery of 75% of the thorium. The remaining thorium, retained in the filtrate as about Mg–9 wt % Th, would be recycled to the dissolution step. The uranium and thorium fractions were successfully melted into buttons by arc melting. Fission product distribution studies showed that about 5% of the total activity remained in the recovered uranium-rich phase, and about 15% remained in the recovered thorium concentrate. The mixed solvent, silver–magnesium, was briefly studied and shows promise for separating uranium and thorium. (auth)

8811 (NAA-SR-6802) THORIUM FUSED SALT ELECTRODEPOSITION INTO A MOLTEN ZINC CATHODE. Ralph E. Johnson (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 15, 1962. Contract AT(11-1)-Gen-8. 17p.

An improved technique has been developed for electrorefining thorium into molten zinc at 600°C, using a fused salt bath of $LiCl-KCl-ThCl_4$. Stirring the zinc markedly improved the current efficiency. Fifteen weight percent $ThCl_4$ was found to be the concentration at which approximately 100% current efficiency is obtained at the cathode between current densities of 0.02 and 0.53 amp/cm^2. The practical limit for the deposition of thorium into zinc at 600°C is about 15 wt %, at which concentration the alloy becomes paste-like and renders stirring difficult. (auth)

8812 (NAA-SR-Memo-6596) GAS PHASE PROCESSING OF IRRADIATED UO_2 AND UC. J. E. Bodine and J. Guon (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 20, 1961. Contract [AT(11-1)-Gen-8]. 23p.

One-hundred-gram quantities of UO_2 and UC irradiated to 15,000 Mwd/MTU were processed by gas phase oxidation-reduction. UO_2 powders were made with trap densities of 1.7 g/cm^3 and less. Approximately 2% of the oxide would not pulverize to −200 mesh after 5 cycles. UC can be used as feed material for this process, though greater care in oxidation is required because of the highly exothermic reaction. Results from experiments using 100 g of 15,000 Mwd/MTU, UC, indicated complete conversion to oxide can be accomplished in a controlled manner. (auth)

8813 (ORNL-TM-22) DISSOLUTION OF ZIRCONIUM REACTOR FUELS IN TITANIUM EQUIPMENT. T. A. Gens (Oak Ridge National Lab., Tenn.). Oct. 11, 1961. Contract [W-7405-eng-26]. 17p.

Continuous dissolution of Zircaloy-2 in a titanium dissolver appears practical using as a dissolvent refluxing 3 M $HNO_3-1.2$ M $HF-0.4$ M $HBF_4-0.6$ M $Cr(III)-0.4$ M $Cr(VI)-0.46$ M Zr. Dissolution and corrosion rates were 10 mg/cm^2−min and 0.0 mil/mo in short term tests, respectively. A stable product solution containing 0.36 M Zr was obtained after addition of aluminum nitrate to complex fluoride ion. Another reagent investigated for use in continuous dissolution was 16 M $HNO_3-2.6$ M $F-0.025$ M $HBF_4-1.4$ M Zr with short term titanium corrosion rates of 0.0 mil/mo. However, Zircaloy-2 dissolution rates were only 3 mg/cm^2-min in the latter reagent. (auth)

8814 (ORNL-TM-111) HOT CELL DEMONSTRATION OF ZIRFLEX AND SULFEX PROCESSES. Report No. 1. J. H. Goode and M. G. Baillie (Oak Ridge National Lab., Tenn.). Jan. 11, 1962. Contract W-7405-Eng-26. 11p.

Four runs were conducted in the Zirflex-Sulfex headend hot cell equipment. Prototype PWR blanket rods, Zircaloy-2 clad UO_2, irradiated from 159 to 356 Mwd/t and decayed 2 years, were declad in boiling 6 M NH_4F-1 M NH_4NO_3, terminating with a F/Zr mol ratio of 7 in the spent decladding solution. Average decladding time was 1.5 hr, leaving end cap residues of about 5 g per pin. At the end of the decladding, maximum loss of uranium and plutonium to the decladding solution was 0.04 and 0.37%, respectively. The core pellets were largely shattered with less than 0.5 wt % smaller than 10 mesh. Core dissolution was complete in 5 M HNO_3 in about 40 minutes, yielding a solvent extraction feed containing 4 M HNO_3 and 100 g U/l. Solid residue from the decladding and core dissolution was less than 0.001% of the initial weight and consisted of traces of Ca, Fe, Cr, and Sn; uranium and plutonium were not detected. (auth)

8815 (TID-14694) THE SEPARATION OF SOME OF THE RADIOACTIVE FISSION PRODUCTS BY ELECTRODIALYSIS. V. A STUDY OF THE CHEMICAL BEHAVIOR OF ZIRCONIUM IN AQUEOUS SOLUTIONS BY MEANS OF ELECTRODIALYSIS AND LIQUID-LIQUID EXTRACTION. Progress Report, December 1, 1960−December 1, 1961. C. W. Brauer, J. N. Click, and W. H. Webb (Missouri. Univ., Rolla. School of Mines and Metallurgy). Contract AT(11-1) 770. 12p.

Work on the electrodialysis and extraction with thenoyltrifluoroacetone (TTA) of zirconium from nitric acid solutions is described. Data showed that very little zirconium was dialyzed from nitric acid systems from which nearly 100% of the zirconium was extractable. The general behavior of systems containing Zr^{95} in HCl systems was suggestive of predominant polymeric species along with some cationic groups. Nothing was found which indicated the presence of any but anionic species in the hydrofluoric, oxalic, and sulfate systems. (M.C.G.)

8816 THE EFFECT OF COMPLEXING ON THE SEPARATION OF ELEMENTS BY COCRYSTALLIZATION. N. B. Mikheev and L. M. Mikheeva (Inst. of Physical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 141: 1109-12(Dec. 11, 1961). (In Russian)

The homogeneous distribution of a micro component between a crystalline precipitate and a solution can be represented by the relation: $x/y = D_0(1-x)/(1-y)$, where x and y are the concentrations of the micro and macro components in the precipitate, $(1-x)$ and $(1-y)$ are the concentrations in solution, and D_0 is the distribution coefficient. D_0 is > 0, but $<$ infinity. The further D_0 is from 1, the greater is the degree of separation between the two elements. It is not difficult to show that on introducing a complexing agent, a new homogeneous distribution coefficient is obtained such that in the limiting case $D = D_0(\beta'/\beta)$, where β is the stability constant for the microelement complex and β' is the stability constant for the macroelement complex. Thus, $D_0 = 0.13 \pm 0.01$ for the carrying of Sr^{90} on barium nitrate in the absence of a complexing agent. Since Sr forms a stronger complex with complexone III than does Ba, the distribution coefficient for Sr was observed to decrease from 0.13 to 0.007 with increasing concentration of complexing agent. A logarithmic, Doerner-Hoskins type of distribution was also considered. $Ba(NO_3)_2$ was precipitated by adding $Cu(NO_3)_2$ to a solution containing $Na_2[Ba(EDTA)]$ and Sr^{90} tracer. The value of λ does not depend on the percentage of barium precipitated, and was found to be 0.0032 which is close to a calculated value of 0.0043. (TTT)

8817 LET'S BE REALISTIC ABOUT FUEL REPROCESSING COSTS. Bernard Manowitz (Brookhaven National Lab., Upton, N. Y.). Nucleonics, 20: No. 2, 60-4(Feb. 1962).

Results are presented from cost studies of reprocessing plant operations. The studies consider several types of reprocessing plant concepts on three different scales of operation and for the fuel types of four different reactors (Yankee, Dresden, Consolidated Edison, and Enrico Fermi). The results are compared with AEC charges and it is shown that the AEC reprocessing costs are anywhere from 0.5 mill/kwh up to several mills per kilowatt-hour higher when added to the power costs for these reactors. The AEC did not include the fuel reprocessing costs in computing the costs of nuclear power. Recommendations are given for lowering fuel reprocessing costs. (N.W.R.)

8818 THE RADIOCHEMICAL SEPARATIONS OF U–Th, Th–RARE EARTHS ELEMENTS AND Th–Pa–U ON SMALL ION-EXCHANGE COLUMNS. Marian Gasior, Jan Mikulski, and Ignacy Stroński (Inst. of Nuclear Physics, Polish Academy of Sciences, Krakow). Nukleonika, 6: 757-64(1961). (In English)

The radioisotopes U^{238}, Th^{234}, Pa^{233}, Yb^{169}, and Lu^{171} were used in studies on the separation of small amounts of uranium and thorium, thorium and lutetium or ytterbium, and of thorium, protactinium, and uranium by the ion-exchange method using the ionites KU-2, Wofatite-F, and ASD-2. (auth)

8819 SOLVENT EXTRACTION OF CATIONS WITH ALKYL PHOSPHORIC ACIDS FROM SULPHATE SOLUTIONS. I. SOLVENT EXTRACTION OF U(VI) AND Fe(III) WITH DODECYL PHOSPHORIC ACID IN THE PRESENCE OF DIFFERENT CATIONS. T. S. Urbanski and S. Minc (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 6: 765-73(1961). (In Russian)

The influence of different cations at various concentrations on the partition of U^{6+} and Fe^{3+} with dodecyl phosphoric acid (DDPA) at constant ionic strength and variable acidity from sulfate solutions was studied. The dependences of the logarithm of the uranium extraction coefficients (E^0_w) on pH of the aqueous solution in equilibrium in the presence of different cations are similar. The increases of pH causes rapid differentiation of the extraction coefficients of U^{6+} even at low concentrations of different salting-out cations. Thus, the corresponding extraction coefficients may be arranged as follows: H < Zn, Mg, Li < Na < K < Rb < Cs. The slope of the curves diminishes from Mg and Li towards Cs, causing the reverse order at lower acidities. In the higher pH region used the slopes of the curves in the presence of Zn or Mg decrease. The curves for Fe^3 extraction are also similar among themselves. The maxima at pH 2 were found. At higher acidities the order becomes: Zn > Mg > Li > Na > K, Rb > Cs. (auth)

8820 THE SEPARATION OF TIN, TELLURIUM AND ANTIMONY IONS BY REVERSED-PHASE CHROMATOGRAPHY. J. Mikulski and I. Stronski (Inst. of Nuclear Physics, Polish Academy of Sciences, Krakow). Nukleonika, 6: 775-8(1961). (In Russian)

The application of reversed-phase partition chromatography in the system TBP–HCl to the separation of Sn(II) and Sn(IV), as well as Sn(II), Te(IV), and Sb(V) ions is described. The radioactive indicators $Sn^{113,123}$, Sb^{124}, and Te^{127m} were used in the investigations. (auth)

8821 ANIONITE ADSORPTION OF NITRIC ACID FROM ORGANIC SOLUTIONS. V. M. Mikhailov. Zhur. Neorg. Khim., 6: 2809-13(Dec. 1961). (In Russian)

The static capacities of certain weak- and strong-base anion resins for HNO_3 in tributyl phosphate were determined, and it is shown that anion resins can be used in preparing neutral uranyl nitrate solutions of TBP in an inert diluent. Aspects of nitric acid and uranyl nitrate anion absorption mechanisms are discussed. (R.V.J.)

8822 SEPARATION OF HEAVY METALS. Anil K. De. New York, Pergamon Press, 1961. 308p. $9.00.

The theoretical and practical aspects of liquid-liquid extraction and ion exchange processes are described along with the analytical and radiochemical procedures used in the separation of about fifty heavy metals. The information is thus a survey of the literature for nuclear energy separation processes. (N.W.R.)

8823 SEPARATION OF CURIUM AND AMERICIUM. Paul R. Fields and Nadine M. Isaac (to U. S. Atomic Energy Commission). U. S. Patent 3,022,134. Feb. 20, 1962.

Curium and americium are contained in an anhydrous molten salt medium having a low melting point. Curium is preferentially extracted from the molten salt by a hot organic solvent containing preferably less than 10% alkyl phosphate. (AEC)

8824 RECONDITIONING FUEL ELEMENTS. Herman L. Brandt (to U. S. Atomic Energy Commission). U. S. Patent 3,022,160. Feb. 20, 1962.

A process is given for decanning fuel elements that consist of a uranium core, an intermediate section either of bronze, silicon, Al–Si, and uranium silicide layers or of lead, Al–Si, and uranium silicide layers around said core, and an aluminum can bonded to said intermediate section. The aluminum can is dissolved in a solution of sodium hydroxide (9 to 20 wt %) and sodium nitrate (35 to 12 wt %), and the layers of the intermediate section are dissolved in a boiling sodium hydroxide solution of a minimum concentration of 50 wt %. (AEC)

8825 REPROCESSING URANIUM DIOXIDE FUELS. Leslie Burris, Jr. and Alfred Schneider (to U. S. Atomic Energy Commission). U. S. Patent 3,023,097. Feb. 27, 1962.

A method of selectively reducing plutonium oxides and the rare earth oxides but not uranium oxides is described which comprises placing the oxides in a molten solvent of zinc or cadmium and then adding metallic uranium as a reducing agent. (AEC)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

Refer also to abstract 9588

8826 (AERE-R-3346) AN AUTOMATIC PUNCHED TAPE TO PUNCHED CARD CONVERTER. R. L. Elliott (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Oct. 1961. 64p.

A tape-to-card converter is designed to process the recorded data from either a 1000-channel neutron-velocity spectrometer, a magnetic tape analyzer, or a single-crystal neutron spectrometer. The equipment uses telephone-type relays to control a tape reader and a card punch, giving accurate conversion at a reasonable speed. (auth)

8827 (AFOSR-1940) CHARGING, INITIAL ACCELERATION AND DETECTION OF MICRON DIAMETER PARTICLES. E. P. Palmer, D. R. Harrison, and R. W. Grow (Utah. Univ., Salt Lake City. High Velocity Lab.). Dec. 5, 1961. Contract AF49(638)-462. 45p. (OSR-21)

Small particles may be accelerated to high-velocities by charging the particles electrically and then accelerating them through a high voltage such as that produced by a Van de Graaff generator. Besides producing a high voltage, the chief problems met in electrostatic acceleration are those concerned with handling the particles, placing a charge on them, maximizing their charge-to-mass ratio, and measuring particle size and velocity. A system was developed to solve these problems. A measure of the over-all effectiveness of the charging system is given by the particle charge-to-mass ratio since this determines the velocity which can be attained. It was found that for carbonyl-iron spheres of 0.2 to 1.1-micron radius, the attainable charge to mass ratio is given by the formula $q/m = (6.13 \times 10^{-6})r^{-1}$ where q is charge, m is mass and r is particle radius; M.K.S. units are used. It is believed that this represents close to the practical maximum value attainable using contact charging and that the limit is imposed by electrical stresses in the particle surface causing surface disruption and ion emission. The limit is lower than that expected for a smooth sphere with a uniform surface-field intensity because of field distortion when the particle and charging probe are in contact and due to a rough and non-homogeneous particle surface. It was found that particle mass could be determined within 20%. This serves as a measure of the over-all effectiveness of the detection system since mass is calculated from measured velocity, charge, and accelerating voltage. (auth)

8828 (ANL-6457) FACILITY FOR PHOTOGRAPHING IN-PILE MELTDOWN EXPERIMENTS IN TREAT. G. H. Golden, C. E. Dickerman, and L. E. Robinson (Argonne National Lab., Ill.). Jan. 1962. Contract W-31-109-Eng-38. 23p.

Techniques and equipment were developed for photographing of samples during in-pile meltdown experiments in TREAT. The design and materials for the transparent meltdown facility are described. The procedures for assembly, insertion in TREAT, removal, and disassembly are outlined. (M.C.G.)

8829 (ARGMA-TR-2H2R) A SPARK DISCHARGE FOR WEAPONS EFFECTS SIMULATION. (A FEASIBILITY STUDY). T. G. Roberts, W. L. Hales, T. A. Barr, Jr. (Army Rocket and Guided Missile Agency, Redstone Arsenal, Ala.). Oct. 27, 1961. 38p.

A fully ionized plasma device for the production of gases at extremely high temperatures is designed, constructed, and tested. This machine is a linear discharge device of the "pinch" type. The plasma thus produced is studied by Kerr cell photographs, time-integrated spectra, and time-resolved spectra. The voltage and current wave forms are also recorded. Experiments are conducted to evaluate the effectiveness of the high-intensity transient radiation pulses in producing damage to materials. (auth)

8830 (DC-58-8-77) DUCT JOINT DEVELOPMENT EFFORT. Summary Report. R. A. Lofy (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 25, 1958. Contract AT(11-1)-171. 57p.

Technical reference is provided in support of test results on duct disconnect development design and development work with pertinent test results on application of duct and component couplings to ANP power plants to date is recorded and recommendations are made concerning the course of future effort. (auth)

8831 (DESY-A2.83) VORSCHLAG ZUM BAU EINES STRAHLHÄRTERS FÜR EINEN GAMMA-STRAHL UNTER VERWENDUNG EINES KONSTANTEN MAGNETFELDES. (Proposal for Construction of a Radiation Hardener for a Gamma Beam by Using a Constant Magnetic Field). Cord Passow (Deutsches Elektronen-Synchrotron, Hamburg). Nov. 1, 1961. 5p.

A gamma ray hardener is designed which comprises LiH layers of thickness $\sim 0.10\ \lambda$ and separated by spaces permeated by a magnetic field. The Compton effect is optimized with negligible contributions from Bremsstrahlung and pair production, and the peak at low energies observed for ray hardeners without magnetic fields is avoided. (D.L.C.)

8832 (HW-68913) PISTON PULSE GENERATORS FOR SOLVENT EXTRACTION COLUMNS. V. L. Hammond and V. P. Kelly (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 20, 1961. Contract AT(45-1)-1350. 15p.

Carbon-graphite pistons and rod seals have been tested with stainless steel cylinders and rods in a variety of pulsed solvent extraction columns to develop leak-free pulse generators which are both radiation and mechanically stable. Two basic types of pulse systems, the U-column and J-column, were studied. The U-column piston pulse system is recommended, where building geometry permits, for two reasons: graphite pistons are normally mechanically reliable and durable; and external piston leakage is eliminated in the U-column system. The U-column has an upper pulse leg extending above the piston, acting as a leakage reservoir, which hydraulically balances the liquid head on the piston so that piston leakage on the upstroke and downstroke is equalized. Thus, no piston leakage external to the system occurs. During the tests, comprising nearly 14 million pulse cycles, the U-columns were found to be hydraulically stable, and the pulse efficiency was essentially unity. Contrasted to the U-column pulser, the J-column pulser has no upper pulse leg; has a short piston rod (and more compact assembly); and blocks external piston leakage with two liquid-pressurized rod seals. As compared to the U-pulser, the J-pulser is more complex mechanically and hydraulically, and less fail-safe (piston

leakage occurs if the gland supply fails). Thus, the J-pulser is only recommended for geometry-limited applications where the U-column cannot be used. Leakage from both pistons and rod seals was correlated by plotting a leakage flow friction factor as a function of a modified Reynolds number. The leakage factors approached constant value for higher Reynolds numbers, as is typical in fluid flow. The leakage factor values varied by a factor of 1000. The highest values, representing highest sealing efficiency, were found for commercial rod seal units with lapped sealing joints. Lowest values were found for units fabricated to relatively moderate tolerance and finish specifications. The correlations show fluid leakage past a seal or piston is predictable if the leakage factor can be estimated; and as expected, precision of manufacture is extremely important in controlling seal performance. (auth)

8833 (HW-69781) NON-RADIOACTIVE TESTING OF THE HAPO II STRONTIUM CARBONATE FILTER CASK INSERT. W. V. DeMier (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 29, 1961. Contract [AT(45-1)-1350]. 4p.

Tests were carried out on a filter insert for a cask designed for shipping purified strontium carbonate-Sr^{90} in multi-kilocurie quantities. Strontium carbonate is precipitated from neutral sodium nitrate solutions with potassium bicarbonate. The tests included filter capacity, filtrate losses, washing, product removal procedures, and internal heater tests. Satisfactory performance was obtained in all tests. (D.L.C.)

8834 (HW-72295) DEMONSTRATION OF UNLOADING TECHNIQUE FOR THE HAPO II-2 STRONTIUM FILTER CASK. W. V. DeMier (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 17, 1962. Contract AT(45-1)-1350. 3p.

Non-radioactive testing of the HAPO II-2 cask for shipment of precipitated strontium carbonate was carried out. The capacity of the filter unit was determined to be 1250 g strontium, ~ ⅔ of that for the HAPO II-1 cask. The dried strontium carbonate filter cake dissolved completely in 3 M nitric acid after soaking for 15 min at 100°F, and no cask pressurization occurred. The cartridge-type heater with "cold end" and lead terminations extended beyond the top of the cask was found to be better than that of the HAPO II-1 cask. (D.L.C.)

8835 (NP-11243) ROTATING-SHAFT HELIUM SEAL INVESTIGATION. Status Report. F. K. Orcutt, J. C. Bell, W. A. Glaeser, and C. M. Allen (Battelle Memorial Inst., Columbus, Ohio). Aug. 25, 1959. Contract DA-44-009-eng-3375. 71p.

A research program was conducted to study positive rotating-shaft seals using helium for high-speed turbomachinery. Materials were evaluated to determine their resistance to high-speed rubbing contact in helium, and a theoretical analysis of gas leakage past dry pressure seals was made. It is concluded that a dry face-type shaft seal can be developed if satisfactory primary seal materials can be found. (D.L.C.)

8836 (SCTM-29-59(15)) PULSE AMPLITUDE REGULATOR FOR TRAVELING WAVE TUBE AMPLIFIER. W. R. Finley and R. W. Seavey (Sandia Corp., Albuquerque, N. Mex.). Jan. 29, 1959. Contract AT-(29-1)-789. 18p.

A system using a chopper was designed to stabilize the amplitude of a pulsed oscillator within ±0.1 db for use in automated data systems. Data are given for its performance. (D.L.C.)

8837 (SCTM-300-61(14)) NOTES ON CURRENT TRANSFORMERS AND THEIR CONSTRUCTION. J. J. Newman (Sandia Corp., Albuquerque, N. Mex.). Oct. 1961. Contract [AT(29-1)-789]. 10p.

An introduction is presented to the theory of operation and construction of current transformers. Two transformers have been constructed using these techniques, and the experimental results are discussed. (auth)

8838 (TID-11539) REARRANGED PLANT 4160-VOLT SYSTEM SERVES NEW TEST FACILITY. R. J. Huntemer (Knolls Atomic Power Lab., Schenectady, N. Y.). [nd.]. Contract [W-31-109-Eng-52]. 15p.

Installation resulting in satisfactory operation is described concerning the addition of two 3000-hp motors to an existing plant 4160-volt system served by three 3000 to 3750 kva transformers. (J.R.D.)

8839 (AEC-tr-4667) DEVELOPMENTAL ELECTROCHEMICAL MEASUREMENT METHODS FOR TEMPERATURES UP TO 300°C AND PRESSURES UP TO 100kg/cm². A translation of "Razrabotka Metodiki Elektrokhimicheskikh Izmerenii pri Temperature do 300°C i Davlenii do 100 kg/cm²." V. V. Gerasimov, A. I. Gromova, E. T. Shapovalov, and O. A. Shatskaya (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1961. 21p.

The currently available methods for electrochemical measurements at room temperatures cannot be used at high temperatures. The structural details of an autoclave with an electrolytic junction were developed, guaranteeing contact of the medium in the autoclave with the medium outside of the autoclave while maintaining a pressure up to 100 kg/cm² within the autoclave (at 300°C). A method was developed for measuring electrolytic potentials and for investigating the kinetics of electrode reactions at high temperatures. (auth)

8840 (AEC-tr-4974) IRREGULAR BEHAVIOR OF FLUIDIZED BED SYSTEMS IN RHEOLOGICAL MEASUREMENTS. K. Schuegerl, M. Merz, and F. Fetting. Translated for Argonne National Lab., Ill. from Chem. Eng. Sci., 15: 75-99(1961). 43p.

Rheological measurements in fluidized bed systems were made with the concentric cylinder viscosimeter, and the deviations from the regular behavior of the flow curves were investigated. Density and viscosity measurements were carried out simultaneously to facilitate following the effects of the rotating cylinder on the fluidized bed system. The density was measured by x-ray absorption and the results were statistically analyzed. Characteristic results of the measured shear stresses with simultaneous density measurements, the corresponding mean densities, ρ_{50}, the relative intensities of the density fluctuations, v_{50}, and the degrees of freedom, n_{50}, are tabulated. (B.O.G.)

8841 (FRL-TN-41) GENERATORS WITH STREAMS OF ELECTRIFIED PARTICLES. Marcel Pauthenier (France. Centre National de la Recherche Scientifique. Laboratoire des Hautes Pressions, Bellevue). Translated for Picatinny Arsenal. Feltman Research Labs., Dover, N. J., Apr. 1961. 15p. (AD-257487)

If dusts to be charged in an electric filter are drawn out of the apparatus before noticeable precipitation occurs, the stream of gas carries off a substantial current of electricity on the charged particles. The laws of the charging of particles (here insulating) in a mono-ionized field permit one to calculate the current carried off. The case of a single "ionizer" or beam of parallel ionizers can be pictured as a honeycomb. Certain devices permit several

ionizers to be placed in the same charging circuit. The first monopolar apparatuses described (1, 1.6, and 2 Mv) function under atmospheric pressure and are large in size. Their current is limited, when particle content is increased, by an inverse discharge at the exit of the ionizer between the ground and the electrified cloud (a very visible discharge with glass columns). One is thus led to increase the internal pressure of the generator. (auth)

8842 (IG-Inf.-Ser.-45) ANNULAR RINGS WITH LOCAL DEFORMATION UNDER SUPERCRITICAL EXTERNAL PRESSURE. H. Link. Translated by H. W. Curtis (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Ingr.-Arch., 23: 36-50 (1955). 26p.

The behavior of a circular ring with an externally limited deformation under supercritical external pressure (e.g., in mine shafts) is considered. The work is limited to the representation of the possible equilibrium states of the inner ring. It shows that there are basic forms in which the outer ring presses on the inner ring at several consecutive points at the same pitch. To these forms can be assigned loading zones depending on the number of the contact points. The lower boundaries k^u of this region are determined by the disappearance of the reaction forces, the upper boundaries k^0 by the disappearance of the bending moment at the contact points. A second group of possible equilibrium forms of the inner ring arises during the transition from one basic form to another with a greater number of contact points. Such forms are shown for the transition from the two-point to the three- and four-point contact form. In the first stage, the transition forms are distinguished by the part of the ring bearing against the outer ring, the included angle of which increases with the load value k. In the second state, there occurs a breakdown phenomenon, through which the ring is transformed into a basic state with a greater number of bearing points. The behavior of the restrictedly deformed rings shows, therefore, similarity to a stiff bending beam, if the bending of this beam is constricted on both sides. (auth)

8843 (JPRS-11293) DEVICE FOR MEASURING THE EXCESS REACTIVITY IN A REACTOR. Zdzislaw Celinski. Translated from Nukleonika, 6: 261-6(Apr. 1961). 6p.

The operating principles and the basic technical parameters are described of a device for measuring the excess reactivity in a reactor. Potentiometers whose characteristics correspond with those of the regulating rods are coupled with the rods by gears. The power fed to each potentiometer is provided from an independent winding of the transformer. The scale of the indicating instrument gives a reading of the sum of the voltages taken from the potentiometers, which is proportional to the excess reactivity. (auth)

8844 NEW DESIGN OF A SAFE FOR STORING RADIOACTIVE PREPARATIONS. A. A. Stankevich (Inst. of Oncology, Academy of Medical Sciences, USSR). Problems Oncol. (U.S.S.R.) (English Translation), 7: No. 4, 90-3(1961).

A design is presented for a safe for storing high-level radioactive preparations which minimizes the amount of γ radiation to which personnel may be exposed while removing or replacing preparations. The safe is recommended for use in radiology departments of cancer hospitals. (C.H.)

8845 SMALL-FIELD X-IRRADIATION. DESCRIPTION OF A DOG-HOLDING, FIELD-LIMITING UNIT AND DOSIMETRY. Leonard Stanton and Howard J. Barnhard (Hahnemann Medical Coll. and Hospital, Philadelphia and Univ. of Arkansas, Little Rock). Radiology, 78: 199-206 (Feb. 1962).

A flexible, combination dog-holding and x-ray field-limiting device is described. Beam localization is highly accurate and reasonably rapid. Processing of the two or three check films is the most time-consuming portion, but Polaroid "10 second" prints can be used in this application. Air dose was found to drop sharply with smaller field sizes. The problem was solved after realization that the filter served as a line-of-sight contributor of secondary radiation which was encroached upon by the small holes. A lead mask with a 1-in. cut-out, placed immediately above the filter, remedied the situation and reduced the variation of air dose with field size to 1 to 2%. Tissue dosage determinations showed high absorption values, as expected, for very small fields in the 11 to 2-mm. Cu half-value layer range employed. Back-scatter was relatively small. For many practical situations, gain from back-scatter and loss from decreasing field size effectively canceled each other. Thus, only the transmission factor need be considered. Where greater precision is concerned, experimental data are given for making more accurate correction for field size, absorption, and back-scatter effects. The effect of bone mineral on absorbed dose was estimated to be less than 5% per centimeter for animals used in these studies, with beam qualities of 1 to 2 mm. Cu h.v.l. The lack of an accurate microanatomic basis for estimating absorbed dose in such irradiation is emphasized. (auth)

8846 A MULTIPLE-DIAPHRAGM SYSTEM FOR A CESIUM-137 UNIT. Robert S. Landauer (Cook County Hospital, Chicago). Radiology, 78: 256-7(Feb. 1962).

A set of diaphragms was constructed for a Cs^{137} teletherapy unit. A brass frame, attached to the 27-cm. cone, serves as a holder for the diaphragm drawers. The drawers are brass boxes, $4\frac{1}{4}$-in. square, filled with lead, and with square and rectangular openings, which serve as the diaphragms. The field sizes provided are 5 × 5 cm., 6 × 8 cm., 7 × 7 cm., 8 × 10 cm., 8 × 15 cm., 10 × 10 cm., 10 × 15 cm., 12 × 15 cm., and 15 × 15 cm. A visual distance indicator is provided. (M.C.G.)

8847 METHODS OF TESTING HIGH QUALITY AEROSOL FILTERS FOR THE COLLECTION OF RADIOACTIVE AEROSOLS AND FROM THE PERSONAL SAFETY ASPECT. D. Hasenclever. Staub, 21: 281-5(July 1961).

Three devices for testing aerosol filters for collection of radioactive aerosols (quartz dust, oil mist, and test apparatus using radioactively labelled aerosols) are described. The requirements for a dust mask for protection against radioactive dusts are discussed with respect to filter efficiency and test results on reactor filter materials. It is shown that testing with aerosols of only 1 size or of a narrow size range is inadequate for the positive assessment of a filter material. A 4th apparatus now under construction, for testing high efficiency filter cells by means of oil mist up to a loading of 3000 m^3/hr., is mentioned. (APCA)

8848 GAMMAGRAPH APPARATUS FOR MEDICAL PURPOSES. Archimiro Caha and Kamil Kallusch. British Patent 887,490. Jan. 17, 1962.

A gammagraph apparatus is designed for detecting sites of radioactivity within the human body for diagnostic, therapeutic, and other medical purposes. The apparatus comprises a scintillation head and support means, the support means being constructed so that the head can be moved along the human body to follow its curvature. A recording cylinder is carried by the frame, and only one electric motor is required. (D.L.C.)

8849 IMPROVEMENTS RELATING TO APPARATUS FOR PRODUCING HIGH VOLTAGE DIRECT CURRENT FROM ALTERNATING CURRENT SOURCES. Arthur Stephen Husbands (to Associated Electrical Industries Ltd.). British Patent 887,659. Jan. 24, 1962.

A Cockcroft-Walton apparatus is designed for obtaining high d-c voltage by rectification and multiplication of a lower a-c voltage. The apparatus includes hinged rectifier units for reversing the polarity of the output, and the need for an extra rectifier or capacitor is avoided. (D.L.C.)

8850 IMPROVEMENTS IN OR RELATING TO THRUST BEARINGS. Stanley Whitley and Leonard Glyndwr Williams (to United Kingdom Atomic Energy Authority). British Patent 887,695. Jan. 24, 1962.

A gas-lubricated thrust bearing is designed which is of simplified construction. The bearing comprises two optically flat plates having on one plate a series of three or more radial feed grooves and a series of arc-shaped concentric viscosity grooves which terminate before the next feed groove is reached. (D.L.C.)

8851 PRESSURE VESSELS. Arthur Francis Gardiner Austin (to Head Wrightson and Co., Ltd.). British Patent 887,776. Jan. 24, 1962.

A cylindrical pressure vessel is designed with provision for support. The vessel comprises a cylindrical shell with its lower end closed by a tapered section to which is secured a solid end cap. Support is effected by means of a ball race bearing the end cap. (D.L.C.)

8852 IMPROVEMENTS IN VAPOUR GENERATORS. Peter Anthony Taylor (to Babcock and Wilcox Ltd.). British Patent 888,089. Jan. 24, 1962.

A vapor generator for marine nuclear power plant installations is designed for a high degree of rigidity. The generator comprises a lower drum containing a bank of heat exchange tubes, an upper drum containing water and steam separating equipment, and upright riser tubes enclosed within downcomer tubes and connecting the two drums. As the riser tubes are subjected to only the differential pressure between the upflowing steam–water mixture and the downflowing water, they may be made relatively thin. The drums may also be brought very close together for additional rigidity. (D.L.C.)

8853 IMPROVEMENTS IN OR RELATING TO JOURNAL AND JOURNAL BEARING ASSEMBLIES. Stanley Whitley and David Shaun Allen (to United Kingdom Atomic Energy Authority). British Patent 888,155. Jan. 24, 1962.

A gas-lubricated journal and journal bearing assembly is designed which does not require a source of pressurized gas to suppress whirl. The journal bearing has a cylindrical bearing surface with a ring of three or more circumferential viscosity grooves at each end. In operation, the rotation of a journal shaft in the bearing causes gas to be pumped into the grooves, thereby suppressing whirl. (D.L.C.)

8854 VAPOUR GENERATING PLANT. (to Sulzer Frères, Société Anonyme). British Patent 888,713. Feb. 7, 1962.

A vapor generating plant is designed for using the heat generated by a reactor. The plant comprises a number of vapor generators designed for different ranges of temperature and pressure and supplied in parallel by a feed pump, and throttles are disposed in parts of the plant where the maximum-pressure feed liquid has passed through preheaters. (D.L.C.)

8855 A MAGNETIC GRID FOR CONTROLLING A CHARGED PARTICLE DISCHARGE. (to U. S. Atomic Energy Commission). British Patent 889,198. Feb. 7, 1962.

A grid device is designed which employs magnetic forces to control completely the passage of charged particles in an electrical discharge. The device is a planar magnetic grid which comprises two electrical conductors spaced apart and designed so that electrical current is passed in opposite directions in adjacent portions of the conductors to establish a magnetic field. (D.L.C.)

8856 GLOVE BOX ATTACHMENT. Harvey L. Butts (to U. S. Atomic Energy Commission). U. S. Patent 3,020,647. Feb. 13, 1962.

This invention comprises a housing unit to be fitted between a glove box port and a glove so that a slidable plate within the housing seals off the glove box port for evacuation of the glove box without damage to the glove. The housing and the glove may be evacuated without damage to the glove since movement of the glove is restricted during evacuation by the slidable plate. (AEC)

8857 FLEXIBLE COUPLING. E. F. Babelay (to U. S. Atomic Energy Commission). U. S. Patent 3,020,736. Feb. 13, 1962.

A flexible shaft coupling for operation at speeds in excess of 14,000 rpm is designed which requires no lubrication. A driving sleeve member and a driven sleeve member are placed in concentric spaced relationship. A torque force is transmitted to the driven member from the driving member through a plurality of nylon balls symmetrically disposed between the spaced sleeves. The balls extend into races and recesses within the respective sleeve members. The sleeve members have a suitable clearance therebetween and the balls have a suitable radial clearance during operation of the coupling to provide a relatively loose coupling. These clearances accommodate for both parallel and/or angular misalignments and avoid metal-to-metal contact between the sleeve members during operation. Thus, no lubrication is needed, and a minimum of vibrations is transmitted between the sleeve members. (AEC)

8858 MULTIPLE ELECTRON BEAM ION PUMP AND SOURCE. Robert E. Ellis (to U. S. Atomic Energy Commission). U. S. Patent 3,022,933. Feb. 27, 1962.

A vacuum pump is designed which operates by ionizing incoming air and by withdrawing the ions from the system by means of electrical fields. The apparatus comprises a cylindrical housing communicable with the vessel to be evacuated and having a thin wall section in one end. Suitable coils provide a longitudinal magnetic field within the cylinder. A broad cathode and an anode structure is provided to establish a plurality of adjacent electron beams which are parallel to the cylinder axis. Electron reflector means are provided so that each of the beams constitutes a PIG or reflex discharge. Such structure provides a large region in which incoming gas molecules may be ionized by electron bombardment. A charged electrode assembly accelerates the ions through the thin window, thereby removing the gas from the system. The invention may also be utilized as a highly efficient ion source. (AEC)

8859 COUPLER FOR TOOL AND CABLE. William E. Cawley and Charles E. Frantz (to U. S. Atomic Energy Commission). U. S. Patent 3,023,040. Feb. 27, 1962.

A two-part device is designed for pulling a splitting tool through a fuel tube. The device can be readily disconnected by unthreading the parts by means of a movable head carrying a transverse key which fits into a slot in the threaded part attached to the cable. (AEC)

8860 MOLDS FOR CASTING PLUTONIUM. John W. Anderson, F. Miley, and W. C. Pritchard (to U. S. Atomic

Energy Commission). U. S. Patent 3,023,119. Feb. 27, 1962.

A coated mold for casting plutonium comprises a mold base portion of a material which remains solid and stable at temperatures as high as the pouring temperature of the metal to be cast and having a thin coating of the order of 0.005 inch thick on the interior thereof. The coating is composed of finely divided calcium fluoride having a particle size of about 149 microns. (AEC)

Heat Transfer and Fluid Flow

8861 (ANL-6441) HEAT TRANSFER WITH LAMINAR FLOW IN CONCENTRIC ANNULI WITH CONSTANT AND ARBITRARY VARIABLE AXIAL WALL TEMPERATURE. R. Viskanta (Argonne National Lab., Ill.). Dec. 1961. Contract W-31-109-Eng-38. 48p.

An analysis has been performed to determine the heat transfer characteristics for laminar forced-convection flow in a concentric annulus with prescribed surface temperatures. Three distinct problems were considered: (a) wall temperature prescribed at both the inside and outside wall; (b) inside wall temperature prescribed and the outside wall insulated; and (c) inside wall insulated and outside wall temperature prescribed. The solution for temperature distribution was similar to that obtained by Graetz for laminar heat convection in a pipe with uniform wall temperature. Expressions are presented for heat flux, mixing cup temperature, and Nusselt number as a function of downstream position. Eigenvalues and eigenfunctions were computed for values of the ratio of the inside to the outside radii for the boundary conditions. Mixing cup temperatures, local and fully developed Nusselt numbers, and thermal entry lengths are presented graphically. The solution of Problem (a) was extended to the situation in which the temperatures of the inside and outside walls of the annulus are not equal. By utilizing the method of superposition and the solutions already obtained for Problem (a), the temperature distributions were determined. By way of illustration, heat fluxes were calculated for several values of the temperature ratio $(T_{w_i}-T_0)/(T_{w_0}-T_0)$. Results were generalized to apply to the situation of arbitrary longitudinal variation of the wall temperatures of the annulus. As an illustration of the method, an extension is explicitly given for a linear increase of all temperature with axial distance. (auth)

8862 (BAW-168) CORRELATION OF CRITICAL HEAT FLUX FOR BOILING WATER IN FORCED CIRCULATION AT ELEVATED PRESSURES. Robert H. Wilson and James K. Ferrell (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). June 8, 1961. Revised Nov. 6, 1961. 34p.

The development of a critical heat flux correlation for water in forced circulation at elevated pressures is described. In contrast to earlier correlations in the literature, which present critical heat flux as a function of dependent variables such as outlet subcooling or enthalpy, this correlation presents the critical heat flux as a function of the independent variables, mass velocity, channel thickness, channel length, and subcooling at the channel inlet. Comparisons with experimental data in the form of frequency plots show the superiority of this critical heat flux equation for correlating existing data. (auth)

8863 (DC-58-6-182) HEAT TRANSFER ANALYSIS OF A HEAT MEASURING DEVICE. R. A. Boudreaux (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 23, 1958. Contract AT(11-1)-171. 21p.

The feasibility of providing a heat measuring device within a control rod guide sleeve to determine the local moderator or control rod internal heat generation rate of the D-102-A was investigated. It is concluded that a system basically comprised of a slug of moderator or control rod material which is thermally isolated within a high vacuum is the most suitable configuration from the standpoint of heat exchange. (auth)

8864 (DC-59-3-223) GENERALIZED THERMAL DESIGN RELATIONSHIPS FOR AIR IN CONDUITS. M. E. Lapides, R. E. Motsinger, and R. J. Spera (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 18, 1959. Contract AT(11-1)-171. 43p.

An analysis and graphic presentations are presented applicable to a variety of reactor thermal design investigations. The analysis establishes relations among reactor component geometry, power level and distribution, coolant flow rates, and resultant temperatures. These formulations can be used for typical thermal design problems such as basic coolant channel sizing, worth of power shaping, off-design performance, and deviation studies. Typical examples of such studies are included. The specific presentations are for the case of turbulent flow of air in conduit-type passages, e.g. tubular systems, plate type fuel elements, however, the same type of presentation can be developed for either alternate coolants or fuel element types. (auth)

8865 (DC-59-4-42) SOLUTION OF HEAT TRANSFER EQUATIONS BETWEEN THREE PARALLEL WALLS WITH AIR FLOW ON BOTH SIDES OF THE CENTER WALL. A. D. Andrews (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 2, 1959. Contract AT(11-1)-171. 38p.

An analysis and programming technique is presented for surface and air temperatures at desired longitudinal positions of a configuration which can be represented by three parallel walls with air flow on both sides of a thin center wall. The program can be applied to shapes other than plane walls as long as the equivalent walls remain parallel. (J.R.D.)

8866 (DC-59-4-115) TRANSIENT TEMPERATURE ANALYSIS OF SYSTEM OF CONCENTRIC CYLINDERS WITH INTERNAL HEAT GENERATION—EA PROBLEM NO. 7-1166—JOB NO. 50030. B. Kaplan (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 11, 1959. Contract AT(11-1)-171. 35p.

The mathematical engineering analysis resulting in a set of equations is presented that can be used in a digital computer solution for obtaining the transient temperature distribution in a system composed of internally heated concentric cylinders. (auth)

8867 (EURAEC-41) DESIGN AND CONSTRUCTION OF A FACILITY FOR HEAT TRANSFER EXPERIMENTS WITH WET STEAM. Special Report No. 1. N. Adorni, L. Berkowitz, G. Peterlongo, M. Silvestri, G. Soldaini, and R. Zavattarelli (Centro Informazioni Studi Esperienze, Milan). July 1960. Work Performed under United States-Euratom Joint Research and Development Program. Contract [002-59-11RDI]. 69p. (CISE-R-23)

A heat transfer facility designed to permit measurements of heat transfer, burnout, and pressure drop phenomena in two-phase flow of steam-water mixtures is described. The facility is a once-through system. A computer code that is developed to reduce the data, an analysis of experimental errors, and the facility's operating manual are also presented. (auth)

8868 (EURAEC-97) CAN-1—QUARTERLY PROGRESS REPORT [NO. 6] FOR THE PERIOD JANUARY 1 TO

MARCH 31, 1961. Part A. Technical Report. (Centro Informazioni Studi Esperienze, Milan). Apr. 15, 1961. Work Performed under United States-Euratom Joint Research and Development Program. Contract 002-59-11RDI. 8p. (CISE-R-37)

Progress is reported on heat transfer experiments in annular ducts, film thickness and flow stability tests, and corrosion and erosion testing of stainless steel and Zircaloy-2 specimens. (B.O.G.)

8869 (EURAEC-150) EXPERIMENTAL DATA ON TWO-PHASE ADIABATIC FLOW: LIQUID FILM THICKNESS, PHASE AND VELOCITY DISTRIBUTION, PRESSURE DROPS IN VERTICAL GAS–LIQUID FLOW. Special Report No. 7. N. Adorni, I. Casagrande, L. Cravarolo, A. Hassid, and M. Silvestri (Centro Informazzioni Studi Esperienze, Milan). Mar. 1961. Work Performed under United States-Euratom Joint Research and Development Program. Contract [002-59-11RDI]. 141p. (CISE-R-35)

Experimental data on upward two-phase Ar–H_2O adiabatic flow in a vertical cylinder are reported. The temperature is maintained at room temperature, and the pressures studied range up to 22 kg/cm^2. Data on film thicknesses, phase and velocity distributions, and pressure drops are given. (T.F.H.)

8870 (HW-68934(Rev.)) THE LOW PRESSURE CRITICAL DISCHARGE OF STEAM–WATER MIXTURES FROM PIPES. F. R. Zaloudek (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1961. Contract AT(45-1)-1350. 46p.

An apparatus was constructed to investigate the critical flow behavior of steam–water mixtures flowing in passages of constant area. Experiments were limited to circular full-bore cross sections of 0.520- and 0.625-inch diameter, and lengths up to 4 feet. Test section exit qualities from 0.4 to 99% and critical mass velocities between 10^3 and 10^5 lb/sec ft^2 were investigated. Corresponding critical pressures ranged from 40 to 110 psia. To facilitate the direct application of the experimental data to the solution of practical problems, the results were correlated by employing the conventional technique of comparing results with theoretical predictions of the homogeneous-flow model. It was found that the correlation could be divided into three distinct parts. At qualities above 20% where an annular or dispersed flow apparently existed, the critical-mass velocity ratio (G_{ob}/G_c) was found to be dependent only on bulk quality of the mixture and relatively independent of the critical pressure and diameter of the test section. In this quality region, the correlation could be expressed by the relation $1 - (G_c/G_{ob}) = 0.556 - 0.420x$. At qualities below 20%, a strong dependency of the critical-mass velocity ratio on the critical pressure was detected. A high critical pressure was generally accompanied by a lower G_{ob}/G_c ratio than that accompanying a lower critical pressure. The critical-mass velocity ratio was apparently independent of the test-section diameter. For qualities below 2% the critical-mass velocity ratio increased tremendously with decreasing quality with values as high as 5.8 occurred at approximately 0.5% quality. In comparing the results with those obtained in similar investigations, it was found that critical-mass velocity ratios were considerably greater than the widely used experimental values obtained by Isbin, Moy, and DaCruz, whose results have come into wide use in design and analysis calculations. However, they do compare favorably over a large range of qualities with a recent work by Faletti. The deviation between the present work and that of Isbin, Moy, and DaCruz was attributed, in part, to the latter's method of experimentation. (auth)

8871 (HW-70791) STUDIES IN MICROMERITICS. II. THE DEPOSITION OF PARTICLES IN CIRCULAR CONDUITS DUE TO THERMAL GRADIENTS. A. K. Postma (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 1, 1961. Contract AT(45-1)-1350. 18p.

The deposition of particles from turbulent gas streams due to thermal gradients was predicted using a simplified flow model. In the model, particle concentration was assumed constant in the turbulent region. The particle deposition velocity was taken to be the radial velocity of thermal repulsion in the laminar sublayer. Temperature gradients in the laminar sublayer were calculated for constant wall temperature using the Reynold's analogy. The loss magnitude of suspended particles from loss due to thermal deposition is not generally great, and is most important for submicron particles. (auth)

8872 (HW-71389) DESCRIPTION OF TRANSIENT SYSTEM HIGH PRESSURE HEAT TRANSFER APPARATUS–189D. K. G. Toyoda (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 23, 1961. Contract AT(45-1)-1350. 20p.

Design considerations and operating procedures for a facility which will permit transient experiments to be conducted on the High Pressure Heat Transfer Apparatus are given. The general system, sizing, steady state-to-transient change mechanism, steam exhaust, location, safety, transient system operation, air pressurizing system, water storage system, valve assembly, vapor condensation, air system, water system, steady-state transient switch valve assembly, operational procedure, and compressed air system hazards are discussed. (M.C.G.)

8873 (KAPL-2170) HYDRODYNAMIC STABILITY OF A BOILING CHANNEL. Alan B. Jones (Knolls Atomic Power Lab., Schenectady, N. Y.). Oct. 2, 1961. Contract W-31-109-Eng-52. 138p.

Experimental observations have been made of spontaneous flow rate oscillations within a coolant channel heated sufficiently to produce boiling. The possibility of burnout or other damage is suggested if such oscillations are sufficiently strong. The derivation is described of a mathematical model for predicting whether such oscillations will occur. A digital computer program is outlined for mechanizing the solution of the equations. The single check against experiment which has been performed to date is described. In this single check, excellent agreement between model and experiment was obtained. (auth)

8874 (NASA-TN-D-1165) ANALYSIS OF HEAT TRANSFER AND PRESSURE DROP FOR A GAS FLOWING THROUGH A SET OF MULTIPLE PARALLEL FLAT PLATES AT HIGH TEMPERATURES. Thomas H. Einstein (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Dec. 1961. 40p.

It is assumed that each plate generates the same amount of heat, and that the set of plates is surrounded by an adiabatic wall. The maximum plate and adiabatic wall temperatures are found theoretically as functions of parameters proportional to the friction factor and the plate geometry. The pressure drop is found as a function of these same parameters, the exit Mach number, and the exit pressure. Both radiative and convective heat transfer processes are considered. Numerical calculations are shown for H_2, with an inlet temperature of 200°R and an outlet temperature of 5000°R, and Mach numbers of 0.2 to 0.8. (T.F.H.)

8875 (TID-14664) BASIC EXPEIMENTAL STUDIES ON BOILING FLUID FLOW AND HEAT TRANSFER AT ELEVATED PRESSURES. Monthly Progress Report for

month of December 1961. Bruce Matzner (Columbia Univ., New York. Engineering Research Labs.). Dec. 29, 1961. Contract AT(30-3)-187. 12p. (MPR-XIII-12-61).

Completion of the "hot rod" test section and receipt of materials for the next two 19-rod test sections are reported. An analysis of the two-phase pressure drop data obtained from running the 19-rod test section revealed that the data are similar to that obtained from the spirally wrapped 7-rod test section. It is thought possible to use these results interchangeably. (J.R.D.)

8876 (WAL-TR-830.5/3) DETERMINATION OF DEFECT GEOMETRY BY ULTRASONIC PULSE ANALYSIS TESTING. Otto R. Gericke and John J. Maguire (Watertown Arsenal Labs., Mass.). Jan. 1962. 20p.

Test specimens containing artificial defects of various configurations were consecutively subjected to a conventional ultrasonic pulse echo test and a pulse reflection method employing polychromatic ultrasonic energy. Results were compared from the viewpoint of the effectiveness of these two methods to differentiate among various flaw geometries. It was found that the polychromatic pulse method permits a more conclusive geometry inspection for defects which are smaller than the ultrasonic search beam diameter. (auth)

8877 (AEC-tr-4511) PROBLEMS OF HEAT TRANSFER. (Voprosy Teploobmena). M. A. Mikheev, ed. Translated from a publication of the Publishing House of the Academy of Sciences, U.S.S.R., Moscow, 1959. 246p.

A collection of articles on studies of heat transfer, the search for methods and materials to increase the flow of heat, and the determination of the thermophysical properties of working media is presented. Subjects are included which deal with the development of processes of heat exchange and of hydraulic resistance at high temperatures with liquid metals as high-temperature media. (M.C.G.)

8878 (AEC-tr-4943) THERMODYNAMIC ANALYSIS OF THE CONDITIONS OF HEAT EXCHANGE IN THE VAPORIZER OF A NUCLEAR POWER PLANT. D. D. Kalafati. Translated from Teploenergetika, 8: No. 6, 16-20(1961). 18p.

The optimum temperature drop in the vaporizer of a nuclear power plant under various operating conditions was determined on the basis of a thermodynamic and technical-economic analysis of the conditions of heat exchange. (auth)

8879 (AEC-tr-4960) FLOW PROCESSES IN ANNULAR GAPS (LABYRINTH SEALS). Ernst Becker. Translated for Oak Ridge National Lab., Tenn. from VDI Zeitschrift, 51: 1133-41(July 20, 1907). 30p.

Turbulent flow processes in annular gaps having irregular cross sections are studied, with particular reference to labyrinth seal applications. Data are presented for water, air, and steam. The resistance characteristics of such flows are examined. (T.F.H.)

8880 (FTD-TT-61-198) AN APPROACH TO DERIVING A FORMULA FOR DETERMINING THE COEFFICIENT OF HEAT TRANSFER FROM A GAS TO A WALL BASED ON THE KINETIC THEORY OF MATTER. N. B. Kadirov. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Neft i Gaz, No. 11, 95-100(1960). 11p.

A formula is derived for theoretically determining the coefficient of heat transfer from a gas to the walls adjacent to it, based on the kinetic theory of matter. The coefficient is found to depend on the molecular weights of both gas and wall, pressure, temperature, and number of degrees of freedom of the gas. (T.F.H.)

8881 (FTD-TT-61-321) ENGINEERING PHYSICS JOURNAL (SELECTED ARTICLES). Translated from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus, S.S.R., 4: No. 3, 10-17; 39-45(1961). 22p.

Two papers are included which respectively treat the heat transfer of laminar fluid flow in pipes and the flow of a burning gas past a plate. A separate abstract was prepared for one of the papers. (D.L.C.)

8882 (FTD-TT-61-321(p.1-11)) CALCULATION OF HEAT TRANSFER DURING LAMINAR FLOW OF A FLUID IN PIPES WITHIN A RANGE OF SMALL PECLET NUMBERS. B. S. Petukhov and F. F. Tsvetkov. Translated from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus, S.S.R., 4: No. 3, 10-17(1961).

A numerical method is used to solve the problem of heat transfer during laminar flow of a fluid in a circular pipe, taking into account the change of heat flux caused by conduction along the axis. A solution is obtained for the case of a constant density of the heat flux at the wall in a range of small Peclet numbers. The results of the calculation are compared with the experimental data on heat transfer of flowing mercury. (auth)

8883 (NP-tr-835) FLOW THROUGH CAPILLARY SPACES. H. Greinacher. Translated by E. Feigl (Translation No. 4987) (Commonwealth Scientific and Industrial Research Organization, Melbourne) from Z. physik. Chem. (Frankfurt), 19: 101-17(1959). 33p. (Includes original, 17p.).

A discussion is presented of the conditions of flow through a cylindrical capillary taken as a model of a porous channel. The equations of the movement of a liquid front are evolved for the case, in which a capillary is immersed in a liquid, first in a horizontal position (pure capillary effect), and secondly in a vertical position (with an additional gravitational effect). An equation for the capillary model of a porous body with a radial arrangement of capillaries is evolved in a similar manner. The conditions of flow through two-dimensional bodies (paper, clay tablets) are then compared with the results obtained. Porous strips wetted on one side and circular discs wetted at the center are subjects of thorough investigation. It was found that the front progresses with increasing $\sqrt{t}$ as in capillaries, in the present case, however, only with large distances of flow. Deviations from this behavior are observed for radial flow. These deviations and the fact that the $\sqrt{t}$ law is not obeyed at the beginning of linear flow are thoroughly discussed. The question to what extent the shape of the curves for vertical flow agrees quantitatively with the flow through capillaries is also considered. For this purpose, a dynamic method of measuring the height of rise in capillaries is developed and its applicability to porous materials tested. Finally, flow solely affected by gravity and especially the dependence of the rate of flow upon the length of flow are considered. Flow patterns indicate to what extent conditions of oriented flow are fulfilled. (auth)

8884 GENERALIZING THE EXPERIMENTAL DATA CONCERNING THE EFFECT OF THE LENGTH OF A HEATED TUBE ON THE CRITICAL HEAT FLUX. Z. L. Miropol'skii and L. E. Faktorovich (Power Engineering Inst., Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 141: 1353-6(Dec. 21, 1961). (In Russian)

It is known that the critical heat flux depends on the length of the heated tube section over a definite range of pressure, heat content and velocity of a steam-water mixture in a tube. The variables in the system can be related by dimensionless numbers for long tubes ($l/d > 100$). However, for values of $l/d < 100$ a parameter A is defined which

depends on l/d and the term $K_w(1-x)^{2.5n}$, where $K_w = (w_g\mu'/\sigma\gamma')(\gamma'/\gamma'')^{0.2}$. Nomograms are given to determine the value of A as a function of the pressure p, the mass flow w_g, the vapor content x and the relative tube length l/d. In calculating the critical heat flux in short tube sections (l/d < 100), the following equation is proposed: $q_c\mu/\sigma\gamma' r = 0.174 A K_w^{0.4} (c_p'T_s/r)^{0.8}(1-x)^n$. This equation is satisfactory when x > 0 at the inlet, or the liquid is not subcooled by more than 150°C. This equation is applicable only with the use of limiting values of the vapor content as a function of pressure: for p = 20 atm., x < 0.9; for p = 180 atm., x < 0.4; and for p = 200 atm., x < 0.25. (TTT)

8885 A QUENCHING THEORY FOR TRANSITION BOILING. S. G. Bankoff and V. S. Mehra (Northwestern Univ., Evanston, Ill.). Ind. Eng. Chem., Fundamentals, 1: 38-40(Feb. 1962).

A quenching theory of transition boiling is proposed, which is consistent with Berenson's data. An interesting result is that the thermal boundary layer in the liquid contacting the surface is very much larger than the critical bubble radius for nucleation. (auth)

8886 THE DEVELOPMENT OF FREE CONVECTION BETWEEN HEATED VERTICAL PLATES. J. R. Bodoia (Westinghouse Electric Corp., Pittsburgh) and J. F. Osterle. J. Heat Transfer, 84: 40-4(Feb. 1962).

The development of free convection in a viscous fluid between heated vertical plates is investigated. The basic governing continuity, momentum, and energy equations are expressed in finite difference form and solved numerically on a digital computer. Results are obtained for the variations of velocity, temperature, and pressure throughout the flow field assuming the fluid to enter the channel with ambient temperature and a flat velocity profile. The flow and heat-transfer characteristics of the channel are studied and a development height established. A comparison is made between the results of this theoretical investigation and the experimental work of Elenbaas. (auth)

8887 ANALYSIS OF FILM BOILING ON VERTICAL SURFACES. J. C. Y. Koh (Boeing Airplane Co., Seattle). J. Heat Transfer, 84: 55-62(Feb. 1962).

The two phase flow problem in laminar film boiling on a vertical flat plate is analyzed. The shear stress and vapor velocity at the vapor-liquid interface are taken into account. The problem is treated by solving simultaneously the boundary-layer equations for the vapor and liquid phases. In contrast to the film-condensation problem where the heat transfer is independent of the $\rho\mu$ ratio, and where the interfacial shear can be neglected for a Prandtl number of unity or larger, it is shown that the $\rho\mu$ ratio is an important parameter in the film-boiling heat transfer, and that the interfacial shear is quite different from zero. (auth)

8888 HEAT TRANSFER BY SIMULTANEOUS CONDUCTION AND RADIATION IN AN ABSORBING MEDIUM. R. Viskanta (Argonne National Lab., Ill.) and R. J. Grosh. J. Heat Transfer, 84: 63-72(Feb. 1962).

Heat transfer by simultaneous conduction and radiation in a thermal radiation absorbing and emitting medium is considered. Consideration is given to a one-dimensional system consisting of two, diffuse, nonblack, infinite, isothermal, parallel plates separated by a finite distance. The space between the plates is filled with a thermal radiation absorbing and emitting medium. The problem is formulated in terms of a nonlinear integro-differential equation and the solution is obtained by reducing it to a nonlinear integral equation. The numerical results are obtained by an iterative method. The temperature distributions and heat transfer are calculated. Two approximate methods for formulating radiant heat-transfer problems are presented and comparisons of the results are made with the most exact solution. (auth)

8889 A COMPARISON OF PREDICTED AND MEASURED FRICTION FACTORS FOR TURBULENT FLOW THROUGH RECTANGULAR DUCTS. J. P. Hartnett, J. C. Y. Koh, and S. T. McComas (Univ. of Minnesota, Minneapolis). J. Heat Transfer, 84: 82-8(Feb. 1962).

The friction coefficient for both laminar and turbulent flow through rectangular channels was analytically and experimentally studied. The analytic expression for the pressure loss in fully established laminar flow was verified by experiment. In turbulent flow, the method of Deissler and Taylor was used to calculate the friction coefficient. The calculated and measured results were in agreement for ducts having large aspect ratios. At aspect ratios less than 5:1, the predicted values of the friction factors were lower than the experimental data, with a maximum difference of 12 per cent evident for the square duct. It was found that the circular-tube correlation accurately predicts the friction coefficient for flow through rectangular ducts of any aspect ratio for Reynolds numbers between 6×10^3 and 5×10^6. Hydrodynamic entrance-length results are also presented in the laminar and turbulent flow ranges for both a smooth and an abrupt entrance configuration. (auth)

8890 CALCULATION OF DENSITY CHANGES IN BOILING COOLANTS. Fred E. Romie (Advanced Tech. Labs., Mountain View, Calif.). J. Heat Transfer, 84: 94-6(Feb. 1962).

The time-average density of a boiling coolant at any axial location along a given flow channel is a function of the coolant pressure, temperature at the inlet to the channel, mass rate of flow, and the axial distribution of the heat input rate. Thus, the time-average local density will be constant, except for variations in these four variables. In predicting the stability or transient behavior of a reactor utilizing a boiling coolant, it becomes necessary to express changes in coolant density as a function of changes in these four variables. The local time-average coolant-density change that exists after steady state is attained, following a change in each of the variables, is derived. The changes in the four variables are sufficiently small to permit use of small-signal analysis. It is observed that equal but opposite fractional changes in the coolant mass rate and the heat input to the coolant will produce the same density change. (N.W.R.)

8891 VORTICITY AND CIRCULATION IN A COMPRESSIBLE VISCOUS FLOW IN THE PRESENCE OF MAGNETIC FIELD. P. L. Bhatnagar. p.194-9 of "Indian Institute of Science Golden Jubilee Research Volume, 1909-1959." Bangalore, India, Indian Institute of Science, 1959. (In English)

The situations under which the irrotational character and circulation are preserved in a motion of a compressible viscous fluid in the presence of a magnetic field are described and equated. (auth)

8892 PRIKLADNAYA TERMODINAMIKHA I TEPLOPEREDACHA. (Applied Thermodynamics and Heat Transfer). I. I. Novikov and K. D. Voskresenskii. Moscow, Gosatomizdat, 1961. 548p.

A survey is made of nuclear reactor thermodynamics and heat transfer, and data for calculating reactor heat removal and conversion into different types of energy are given. (R.V.J.)

8893 RECENT ADVANCES IN HEAT AND MASS TRANSFER. J. P. Hartnett, ed. New York, McGraw-Hill Book Company, Inc., 1961. 410p.

Sixteen papers are presented of analytical and experimental research in the field of heat and mass transfer. The researches are drived directly from engineering problems in nuclear engineering, high-velocity manned and unmanned flight through the atmosphere, and the space exploration program. Much of the information was obtained by the use of electronic computers. The information is presented primarily for practicing engineers and researchers. (N.W.R.)

Instrumentation

Refer also to abstract 9582

8894 (AD-260358) VACUUM THERMIONIC ENERGY CONVERTER. Scientific Report No. 2. J. E. Beggs (General Electric Co. Research Lab., Schenectady, N. Y.). July 1960. Contract AF19(604)-5472. 27p.

Heat is applied to the external surface of one electrode of the converter. The interior surface of this hot electrode operates in a vacuum and is coated so that it is capable of emitting copious numbers of electrons. The other electrode has a coating on its interior surface that can provide a low anode work function so as to increase the energy available to an external load. The output and efficiency of the converter improve as the emitter becomes hotter and as the electrodes are spaced more closely. At an emitter temperature of 1100°C an output of 1 watt/cm^2 and an efficiency of 4.5% can be attained. (auth)

8895 (AEET/TP/1) ON GROWING LARGE SINGLE CRYSTALS OF ANTHRACENE. G. K. Bhide and R. Y. Deshpande (India. Atomic Energy Establishment, Trombay). 1961. 13p.

Large crystals of anthracene (up to 4 cm dia) for scintillation counting were grown successfully by a modified Stockbarger's technique. Anthracene of scintillation grade necessary for this work is obtained by a purification procedure described. (auth)

8896 (AERE-R-3779) A NEUTRON CHOPPER FOR THE DIDO CRYSTAL SPECTROMETER. D. H. Saunderson and C. Duffill (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1961. 14p.

A compact neutron chopper, capable of chopping monoenergetic beams of 0.01 to 0.08 ev, is designed for mounting on the arm of a crystal spectrometer. The chopper is described, and the principle features of its design discussed in relation to the requirements for inelastic scattering measurements. (auth)

8897 (AERE-R-3867) REFRACTIVE INDEX MEASUREMENTS IN A GAS CERENKOV COUNTER. W. Galbraith, G. Manning, and A. G. Parham (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1961. 17p.

The use of high-pressure (0 to 1000 psi) gas Cherenkov counters in high-energy physics experiments requires a knowledge of the refractive indices of suitable gases at various pressures and temperatures. As a guide to the choice of gas, some measured and calculated values are given for a range of pressures and temperatures. The measurements were made with a Rayleigh-type refractometer built into the Cherenkov counter. A full description of the refractometer is given. (auth)

8898 (ASD-TR-61-273) CONSTRUCTION AND CALIBRATION OF A HALL-EFFECT GAUSSMETER. Karl Strnat and Robert A. Wolf (Aeronautical Systems Div., Wright-Patterson AFB, Ohio). June 16, 1961. 22p.

A gaussmeter, based on the Hall effect, was built for laboratory use. It permits quick measurement of steady magnetic fields in ten ranges between 1 gauss and 30 kilogauss. The small indium-arsenide probes facilitate the mapping of non-uniform fields and provide access to the interior of small coils and into narrow gaps. The meter design and calibration are described. (auth)

8899 (CEA-2075) LE COMPROMIS BRUIT-TEMPS DE REPONSE DANS LES PERIODEMETRES A COURANT CONTINU. UN NOUVEAU TYPE DE CIRCUIT. (The Noise-Time Compromise of Response in D-C Period Meters. A New Type of Circuit). G. Friedling (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 55p.

The characteristics of three types of reactor-period-measuring circuits are compared: a linear circuit; a circuit that may be nonlinear, depending on the reactor period; and a circuit that may be nonlinear, depending on the reactor period and power. This last type of circuit has a fast response time if the power is high or the period short, and a slow response time if the power is low and the period long. This circuit permits the noise to be maintained at an acceptable level under all normal working conditions of the reactor. (auth)

8900 (CRP-1055) A PROGRAM FOR THE ANALYSIS OF GAMMA-RAY SCINTILLATION SPECTRA USING THE METHOD OF LEAST SQUARES. A. J. Ferguson (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nov. 1961. 18p. (AECL-1398)

A program for use on the Burroughs 205 computer at Chalk River for the unfolding of gamma scintillation spectra is described. The spectral shapes of the component lines are computed by polynomial interpolation between those of a number of pure lines. The program can find both the intensity and energy of the components. The method of least squares is used. (auth)

8901 (DC-59-6-208) PARAMETRIC PULSE PREAMPLIFIER FOR NEUTRON SENSOR DETECTORS. W. F. Chow (General Electric Co. Electronics Lab., Syracuse, N. Y.). June 16, 1959. For General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati. Contract AT (11-1)-171. 43p.

A feasibility investigation was undertaken to determine whether or not it is theoretically and practically possible to achieve amplification of pulses derived from fission chambers by the use of parametrically operated solid stage devices. The general principle of using parametric devices as pulse preamplifiers in a reactor system was experimentally tested and proven sound. However, it was concluded that the realization of this principle in practical circuits, particularly if the advantages of reduction in noise interference is to be obtained, will depend upon continuing progress in component and material development. (auth)

8902 (DP-373) NEUTRON BLACKNESS TESTER FOR USE UNDER WATER. John D. Anthony (Du Pont de Nemours (E. I.) and Co. Savannah River Lab., Aiken, S. C.). Dec. 1961. Contract AT(07-2)-1. 9p.

A neutron blackness tester for use under water was developed for ensuring the continuity of cadmium in cadmium-lined steel divider plates of railroad casks that are used to ship reactor fuel elements. The instrument will detect holes in the cadmium as small as 1.25 inches in diameter. (auth)

8903 (HW-71710) HANFORD CRITICALITY DOSIMETER. P. E. Bramson (General Electric Co. Hanford

Atomic Products Operation, Richland, Wash.). Jan. 24, 1962. Contract AT(45-1)-1350. 21p.

A dosimeter was developed for measuring the neutron dose and spectral distribution from a nuclear radiation excursion. The neutron spectrum measurement yields five energy groups while the dose measurement will give the single collision theory RBE neutron dose over a wide range of neutron energies with an accuracy of ±15% within the range of a few to several thousand rads. Measurement of gamma dose between 10 and 10,000 rads is also provided. The dosimeter offers three advantages over others: absence of pre-dose radioactivity, absence of toxic components, and simple and rapid technique. (J.R.D.)

8904 (IDO-16688) A 4906 CHANNEL TWO-DIMENSIONAL ANALYZER FOR THE MTR VELOCITY SELECTOR. F. L. Petree (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Dec. 22, 1961. Contract AT(10-1)-205. 65p.

The analyzer forms part of the Materials Testing Reactor Velocity Selector Experiment which measures energy change versus scattering angle for subthermal neutrons scattered off a target. It is similar to other time-of-flight analyzers except for certain unique features. Among these features are input and output buffer matrices, a randomly pulsed crystal time-base generator, and a direct 48-transistor drive circuit for the 4096 channel magnetic core matrix. (auth)

8905 (IFA-RS-16) COMPTEURS GEIGER-MÜLLER AUTOCOUPEURS POUR DES TEMPÉRATURES ÉLEVÉES. (Autoextinction Geiger-Müller Counter for Elevated Temperatures). M. Drăghicescu (Academiă R. P. R. Institutul de Fizica Atomica, Bucharest). 1961. 11p.

It is found that the behavior of a self-quenching G-M counter with temperature is determined by the state of the surface of the cathode. It is established that in the region of the thermal threshold, the photosensitivity of the counter varies rapidly as regards the maximum wavelength of which the counter is sensitive. In order to obtain counters that will function at high temperatures, techniques are described for forming a stable layer of quenching gas on the cathode surface. (T.F.H.)

8906 (ORO-462) ION BUNCHER AND TIME-OF-FLIGHT EQUIPMENT RESEARCH. Final Report. R. C. Mobley (Louisiana State Univ., Baton Rouge). Aug. 1961. Contract AT-(40-1)-1977. 59p.

A summary is presented of the work done in the development of a variable-path magnetic ion buncher and associated timing equipment capable of respectively generating and timing high-intensity short duration neutron bursts suitable for fundamental studies of nuclear structure by inelastic time-of-flight neutron spectrometry. Test results using 0.5-Mev protons indicated that, except for field strengths, all other operating parameters were identical to those required for 1-Mev deuterons, for which the buncher was designed. An appendix contains modifications to the Van de Graaff accelerator which were necessary for the attainment of the results for the 0.5-Mev protons. (B.O.G.)

8907 (RIB-46) DEVELOPMENT OF HIGH SPEED ELECTRON ACCELERATOR STRUCTURES. Interim Report No. 13, November 1, 1960–March 31, 1961. W. T. Achor and J. A. Zenel (David Sarnoff Research Center, Princeton, N. J.). Contract AT(30-1)-1958. 15p.

A program is in progress to determine the causes of spurious pulses generated by a photomultiplier in complete darkness. A tentative conclusion was that these pulses may be caused by positive ions or other charged particles generated from a region in the vicinity of the first dynode which are accelerated back onto the cathode where they produce secondary electrons. The probability function for secondary emission in photomultipliers is being measured. The rise time characteristics of a photomultiplier tube was determined. (M.C.G.)

8908 (RISÖ-31) THE USE OF POLYVINYL-CHLORIDE FILM FOR Co^{60} RADIATION DOSIMETRY. J. E. Maul, N. W. Holm, and I. G. Draganić (Denmark. Atomenergikommissionen. Forsögsinstitut, Risö). Nov. 1961. 39p.

A systematic investigation was carried out on the coloration induced in commercial PVC film by ionizing radiation in a Co^{60} facility. The color intensity was studied as a function of the following factors: absorbed dose; color development caused by heat treatment under different conditions; fading effect of storage before and after heat treatment; oxygen content of the surrounding atmosphere; irradiation temperature; and thickness of film. The results indicate the possibility of gamma dose measurements in the 0.5 to 5.5 Mrad range. A suitable procedure and well-standardized conditions give a reproducibility better than 10%. Some preliminary experiments carried out with a 10-Mev electron linear accelerator show that the procedure proposed might be useful for accelerator dosimetry, principally for dose-homogeneity measurements. (auth)

8909 (TID-14883) PERIODIC CALIBRATION OF PRESSURE INSTRUMENTATION. CORE 1, SEED 3. Section 1 and 3. (Duquesne Light Co., Shippingport, Penna.). First issue, Feb. 2, 1962. 27p. (DLCS-3360103 and DLCS-3360301)

A test was performed to determine and correct any calibration drift in the reactor coolant loop, pressurizer, and reactor pressure instrumentation and to scale the Data Acquisition System for these parameters. All the pressure indicators showed some drift with the pressurizer pressure with the 1B reactor coolant loop indicators having the greatest amount. All the instrumentation was successfully calibrated during the test. (M.C.G.)

8910 (WADD-TR-60-698(Pt.II)) INTERIM SUMMARY TECHNICAL REPORT I. DESIGN STUDY FOR ADVANCED SOLAR THERMIONIC POWER SYSTEMS. ITEM II–PART II. CLOSE-SPACED VACUUM THERMIONIC GENERATOR. (Thompson Ramo Wooldridge Inc. New Devices Labs., Cleveland and Thermo Electron Engineering Corp., Cambridge, Mass.). Sept. 1960. Contract AF33(616)-7411. 98p. (ER-4166; AD-260066)

A design study on close-spaced vacuum thermionic converters, and design and test specifications for a 28-v, 250-w laboratory test model of this type of converter, are described. The test model consists of 98 cells with 1-in.-square emitters. The model operates at 1500°K and requires a thermal input of 4000 w. (auth)

8911 (AEC-tr-4699) MATRIX TIME ANALYZER WITH MEMORY-CAPACITOR-COMMUTATORS FOR A MECHANICAL NEUTRON SELECTOR. A translation of "Matrichnyi Vremennoi Analizator s Kommutatorami na Emkostyakh Pamyati dlya Mekhanicheskogo Neitronnogo Selektora." A. P. Tsitovich and S. K. Sotnikov (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoĭ Energii). 1960. 19p.

The principle of operation of a 160-channel matrix time analyzer for a mechanical neutron selector is described and its circuits are presented. Fundamental to the matrix circuit are the memory-capacitor commutators and the diode coincidence circuit. The analyzer is calculated to operate with a channel width of from 2 to 120 microseconds. (auth)

8912 (CEA-tr-A-1024) VUE D'ENSEMBLE DES PRÉPARATIONS EXPÉRIMENTALES POUR LA RÉALISATION DES MESURES DE FLUX PENDANT LA PHASE DE DÉMARRAGE DU FR 2. (A General Survey of Experimental Preparations for Making Flux Measurements Pending the Startup Phase of the FR 2). H. (K.) Kapulla (Kernreaktor Bau- und Betriebs-Gesellschaft m.b.H., Karlsruhe, Germany). Translated into French from German report, Nov. 14, 1961. 14p.

Facilities being designed and constructed at the FR-2 reactor at Karlsruhe, for the measurement of the thermal, epithermal, and fast neutron fluxes and of the fast neutron spectra, are described. When the reactor is started up, the equipment described will be able to measure systematically the local thermal neutron fluxes in the core, reflector, experimental channels, and thermal column, at the normal expected power level of 100 w. (T.F.H.)

8913 (CEA-tr-A-1025) DETERMINATION DU FLUX DE NEUTRONS RAPIDES A L'AIDE DE DETECTEURS A SEUIL. (Determination of Fast Neutron Flux by Means of Threshold Detectors). W. Koehler ([Munich. Technische Hochschule]). Translated into French from report FRM-27. Oct. 1960. 30p.

A procedure is described for calculating fast neutron fluxes, by analysis of the activation of threshold detectors. The effective threshold energy is determined from the differential cross section and the calculated spectral distribution of the neutrons. This spectral distribution is calculated for the case of a pool-type reactor, and the effective threshold energy is determined for several types of detectors. (tr-auth)

8914 (CEA-tr-A-1027) DETERMINATION DE LA DOSE DE NEUTRONS PAR LA METHODE D'ACTIVATION. (Determination of Neutron Flux by the Activation Method). W. Koehler (Munich. Technische Hochschule). Translated into French from German Report FRM-32. [1960?]. 9p.

A Co activation method is described for measuring thermal neutron doses. The γ intensity from the reaction $Co^{59}(n,\gamma)Co^{60}$ is used as measure of the dose. (T.F.H.)

8915 (CEA-tr-R-1409) PROCESSUS SECONDAIRES SE PRODUISANT DANS LA SOURCE D'IONS D'UN SPECTROMETRE DE MASSE. (Secondary Processes in Ion Sources of Mass Spectrometers). V. L. Tal'roze and A. K. Lyubimova (Liubimova). Translated into French from Doklady Akad. Nauk S.S.S.R., 86: 909-12(1952). 11p.

The secondary processes taking place in a gaseous-type ion source of a mass spectrometer are studied, for the cases in which the gases are saturated hydrocarbons (methane, ethane, propane, butane), unsaturated hydrocarbons (ethene, propene, isobutene), or water vapor. An increase in the gas pressure is found, in some cases, to increase the concentration of the ion species consisting of the gas plus a proton (e.g., for methane, CH_5^+). The effects of magnetic fields on these concentrations are studied, in order to determine the mechanisms governing the secondary processes. (T.F.H.)

8916 (CEA-tr-R-1417) DETERMINATION DE LA SENSIBILITE DES PHOTOEMULSIONS NUCLEAIRES A L'AIDE DU BETATRON. (Determination of the Sensitivity of Nuclear Photoemulsions with the Aid of a Betatron). K. V. Starinin and E. A. Gruz (Cruz). Translated into French from Pribory i Tekh. Ekspt., 3: No. 5, 28-30 (1958). 6p.

The sensitivity of layers of photographic emulsion may be measured by determining the track density of a charged particle whose energy is known and is above the minimum-ionization energy. The use of a 10-Mev electron beam to make such sensitivity measurements is described, and this method is found to be quite simple and accurate. (T.F.H.)

8917 (FTD-TT-61-56) FIELD INVESTIGATIONS OF SOLAR ENERGY CONVERTERS. A. G. Iosif'yan, A. S. Fialkov, Ya. G. G. Davidovich, O. F. Kuchinskaya, and L. S. Petrosyan. Translated from Vestnik Elektroprom., 31: No. 7, 38-43(1960). 14p.

An experimental study was made of the operating characteristics, efficiencies, environmental effects, and output capabilities of Si semiconductor photoelectric energy converters, used as electric power generators. (T.F.H.)

8918 (FTD-TT-61-261) A SCINTILLATION THERMAL NEUTRON DETECTOR. Yu. K. Khudenskii (Khudenskiy), Yu. A. Tsirlin, and M. N. Baisova-Karakaeva (Baisova-Karakayeva). Translated from Russian Patent No. 133540. Byull. Izobret., No. 22, 25(1960). 2p.

The scintillation detector described uses glycerol and metaboric acid or boric anhydride as the boron-containing compound in place of boric acid. The use of the metaboric acid and boric anhydride results in increases in efficiency without decreasing the optical properties of the detector. (B.O.G.)

8919 (NP-tr-845) THE PHOTOGRAPHIC DENSITY LAW FOR X RAYS. R. Glocker and W. Traub. Translated by J. B. Sykes (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Physik. Z., 22: 345-52(1921). 26p. (Handwritten MS. copy).

It is found that for x rays there is no threshold for the photographic effect. With Hauff x-ray plates and Adurol development at 18°C, the density (S) is proportional to time up to S = 0.6, increases more slowly up to S = 1.3, then becomes proportional to log (time). From 0.4 to 1.1 Å, the density curve is found to be independent of wavelength. Bunsen's reciprocity law is found to be approximately valid. (auth)

8920 A FILTER AGAINST IONS. V. Střelka (Inst. of Physics and Tech., Czechoslovak Academy of Sciences, Prague). Československ. časopis pro fysiku, A 11: 489-92 (1961). (In Czech).

A device eliminating the incidence of ions on an emitter during electron emission experiments with a Geiger-Müller counter is described. The device utilizes the different mobilities of electrons and ions in a gaseous medium. (auth)

8921 A COBALT NEUTRON-FLUX INTEGRATOR. Alan R. Smith (Univ. of California, Berkeley). Health Phys., 7: Nos. 1 and 2, 40-7(Dec. 1961). (UCRL-9212)

A fast-neutron detector, expected to be useful for health physics purposes, is described. The detector is a cobalt disk embedded in a cadmium-cased paraffin moderator. The Co^{60} produced in a disk during irradiation is measured subsequently with a γ-ray scintillation spectrometer to determine the integrated neutron exposure. The 5.3-year half life of Co^{60} permits accurate flux integrals to be obtained from exposure times as long as 1 year. The detector-spectrometer system can measure integrated exposures of 1×10^7 n/cm^2 or greater; the limit on the minimum detectable flux integral is imposed by spectrometer background count rate. (auth)

8922 COMPARISON OF SEVERAL METHODS FOR THE PHOTOGRAPHIC DETECTION OF THERMAL NEUTRON IMAGES. Harold Berger (Argonne National Lab., Ill.). J. Appl. Phys., 33: 48-55(Jan. 1962).

Methods of photographic detection of thermal neutron images were studied and compared with regard to photo-

graphic speed, relative neutron-gamma response, and image sharpness qualities. All these comparisons were made using a low gamma content, monochromatic neutron beam (1.05 A) having an intensity of 3×10^5 neutrons/cm^2-sec. The fastest speed, best neutron-gamma response of the direct exposure methods, and good image sharpness were obtained using a direct exposure method exploying a B-10 loaded scintillator and type F x-ray film. Gadolinium and rhodium intensifier screens with type KK film also yield favorable results by the direct exposure method (film and intensifier screens exposed to the neutron beam together). Results are also reported for the use of indium, cadmium, silver, and gold screens. The transfer method, in which the photographic film is exposed only to the radioactive decay radiation of an image-carrying metallic screen, and not to the neutron beam itself, is useful not only because no effect on the image is produced by gamma radiation in the neutron beam, but also because improved image sharpness is obtained. In the cases of indium and gold (the two materials useful for the transfer method in the neutron flux available for this study), the improved image resolution obtained with the transfer method results because the high energy prompt (n,γ) radiation is not detected on the film. (auth)

8923 LIGHT PULSE FROM HALOGEN-QUENCHED GM COUNTER DISCHARGES. W. P. Davis, Jr. and W. C. Worthington (Dartmouth Coll., Hanover, N. H.). J. Appl. Phys., 33: 126-9(Jan. 1962).

Light pulses associated with the halogen-quenched Geiger-Müller discharge of three commercially available end-window counters were observed using a photomultiplier. Two of the counters were geometrically identical and filled to approximately the same pressure with neon and argon, respectively. The third tube was physically larger and contained neon. An individual light pulse, the duration of which is much shorter than the corresponding normal voltage pulse, has a reproducible and distinctive shape. The amplitude of the light pulse and reciprocal of its rise-time increase approximately linearly with increasing over-voltage. Arguments are given that relate the rise time to the velocity of propagation of the discharge. The smaller of the two neon tubes displayed double pulses over its entire Geiger region while the other tubes seemed entirely free of this phenomenon. (auth)

8924 PHOTOEFFECTS IN SILICON SURFACE-BARRIER DIODES. A. J. Tuzzolino, E. L. Hubbard, M. A. Perkins, and C. Y. Fan (Univ. of Chicago). J. Appl. Phys., 33: 148-55(Jan. 1962).

Silicon surface-barrier photodiodes were fabricated and the steady-state and time-varying photoresponse were measured. The photodiodes are operated in the reverse-bias, or photoconductive mode at room temperature and do not require encapsulation. The average steady-state photosensitivity is 0.31 μa/μw (λ = 5461 A) and 0.065 μa/μw (λ = 2537 A) with approximately 50 A of gold on the sensitive area. With no gold on the sensitive area, the photosensitivity is 0.37 μa/μw and 0.13 μa/μw, respectively. The photoresponse is uniform over the sensitive area (0.1 to 2.5 cm^2) to within a few percent, depending on the wavelength. The high-frequency cutoff is limited by the photodiode capacitance and load resistance. Cutoff frequencies greater than 100 kc have been obtained. The operating characteristics of these devices are reported for six wavelengths lying in the range of approximately 0.2 to 0.6 μ. The possibility of using photodiodes of this type in combination with a scintillator crystal for detecting charged particles is discussed. (auth)

8925 ON CONTACT IONIZATION IN THERMIONIC CONVERTERS. E. S. Rittner and A. Milch (Phillips Labs., Irvington-on-Hudson, N. Y.). J. Appl. Phys., 33: 228-9 (Jan. 1962).

Instances in which the work function ϕ does not exceed the ionization potential I, and the cesium pressure is too low to permit envocation of volume ionization as a result of substantial temperature rise in plasma due to Joule losses, are discussed. Methods of circumventing these difficulties by postulating the presence of regions of sufficiently high work function on the otherwise low work-function emitter surface or by generalizing the concept of contact ionization by using the Saha-Langmuir theory are compared. The latter approach is shown to be more desirable. (L.N.N.)

8926 DEKATRON SCALER EMPLOYING TRANSISTORIZED DRIVE CIRCUITS. G. Bradford and R. B. Galloway (Univ. of Edinburgh). J. Sci. Instr., 39: 11-12 (Jan. 1962).

A scaling circuit is described which has proved extremely reliable, consisting of two dekatron stages followed by a mechanical register. The resolving time of the circuit is 250 μsec. (auth)

8927 ELECTRON ENERGY DISTRIBUTION MEASUREMENTS IN GAS DISCHARGES. B. W. Smithers (Northern Polytechnic, London). J. Sci. Instr., 39: 21-2 (Jan. 1962).

Signals produced by the current in a Langmuir probe circuit have, when modified by a simple differentiating network, been used to obtain electron energy distribution characteristics. Tuned filters are essential for the elimination of spurious signals, and their required properties are discussed. (auth)

8928 ON A 2π GAS-FLOW COUNTER FOR LOW-LEVEL COUNTING. A. Alberigi-Quaranta (Università, Bologna), B. Righini, V. Prodi, and O. Rimondi. Nuclear Instr. & Methods, 14: 13-23(Nov. 1961). (In English)

A low radioactivity level measuring apparatus is described; it is composed of a 2π gas-flow counter without window, whose useful diameter is 4 cm, an anticoincidence scintillation counter, and a shield made by iron bricks and a mercury layer situated between the two counters. Under these conditions the background is equal to 0.62 ± 0.03 cpm; the sensitivity for a counting time of 1000′ is about 0.2 cpm. The gas-flow counter works in the proportional region, where it presents two plateaus, the former corresponding to α-particles and the latter to electrons. The gas used is natural methane. Entirely transistorized electronics is used for elaborating and recording the data given by the counter. (auth)

8929 PULSE SHAPE DISCRIMINATION. L. Varga (Central Research Inst. for Physics, Budapest). Nuclear Instr. & Methods, 14: 24-32(Nov. 1961). (In English)

Pulse shape discrimination methods used up to the present are discussed, considering in particular to what extent the possibilities offered by the shape of the scintillation decay are being exploited. A new method is then described which utilizes in a statistically optimum way and by simplest means the information obtainable from the pulse shapes. The application of this method to the discrimination between proton and deuteron scintillation response of CsI(Tl) crystals is described. Special cases in which the separation can be improved still further are considered. (auth)

8930 SOME NEW PROPOSALS FOR DESIGN OF COMPTON SPECTROSCOPES. Milorad Mladjenović

(Centro Studi Nucleari Della Casaccia, Rome). Nuclear Instr. & Methods, 14: 33-7(Nov. 1961). (In English)

New possibilities of using inhomogeneous magnetic field sectors for Compton spectroscopy are discussed. Among them are spectrographs for (n,γ) measurements, spectroscopes for point gamma sources, and a large radiator, intermediate focus Compton spectrometer, with Siegbahn-Swartholm field. (auth)

8931 SCANNING APPARATUS FOR BUBBLE CHAMBER DATA ANALYSIS. G. Brunhart, C. D. Gall, C. Vittitoe, K. Schneider, and V. P. Kenney (Univ. of Kentucky, Lexington). Nuclear Instr. & Methods, 14: 38-40(Nov. 1961). (In English)

The usefulness of automatic equipment for the analysis of bubble chamber film is enhanced when suitable equipment is available for the preliminary scanning of film to locate the events of interest. Desirable criteria for scanning equipment include ease and speed of operation, low cost, and suitability for use as a simple auxiliary measuring instrument. Two devices which have proved satisfactory in these respects are described. (auth)

8932 THE SOLID ANGLE FILTER, A DIAPHRAGM SYSTEM FOR THE MEASUREMENT OF CHARGED PARTICLES FROM NUCLEAR REACTIONS. B. Conrad (Institut für Experimentalphysik, Hamburg). Nuclear Instr. & Methods, 14: 41-7(Nov. 1961). (In German)

A method to eliminate geometrical errors in measurements of heavy charged particles from nuclear reactions is described. A constant geometry is given by using a mechanical filter, mounted between the target and the detector. Even a three-dimensional target with non-uniform intensity distribution varying in time can be regarded as a point-source in the center of the target-chamber. The method is suited for the investigation of angular distributions. In a measurement of the $Li^7(p,\alpha)\alpha$-reaction, a geometrical accuracy of 0.1% was obtained. (auth)

8933 STATISTICAL ERRORS ARISING FROM USE OF A GATED PULSE TRAIN FOR TOTAL LIVE TIME MEASUREMENT DURING PULSE AMPLITUDE ANALYSIS. M. O. Deighton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Instr. & Methods, 14: 48-52(Nov. 1961). (In English)

Correction of results for counts lost during the analyzer dead time can be overcome automatically by carrying out all counting runs for a known or measured total instrument "live time" rather than for real time as indicated. This method avoids much tedious calculation and remains valid even if the analyzer dead time varies widely from pulse to pulse. The preferred method involves gating by the analyzer of an accurately timed pulse train, which is then counted by a suitable external scaler. Statistical questions raised by such a sampling procedure are considered. It is concluded that a fixed-frequency source at 50 pulses/sec would be satisfactory in most cases. The use of a beam-current integrator, in conjunction with the "live time" gate, is also considered, since this probably offers the best method of dealing with source intensity fluctuations. (auth)

8934 A NETWORK ANALOGUE FOR A QUADRUPOLE LENS SYSTEM. C. F. Coleman (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Instr. & Methods, 14: 53-62(Nov. 1961). (In English)

An analog model for a system of quadrupole lenses is described. If such a lens system has two planes of symmetry through its axis, the action of the system on displacements from these two planes is equivalent to that of two corresponding sets of cylindrical lenses. In the model these cylindrical lenses and the intervening distances are represented by successive parallel and series impedors in an a-c network. From the model direct information can be obtained on those transformations of elliptical phase space boundaries that are used to describe the transport of particle beams through lens systems. It can be used to investigate the restrictions that slits within the system impose on the available phase space at the input, and leads to a particularly straightforward method for finding a system that accepts a beam with given characteristics and produces an output with waists at specified positions. (auth)

8935 AN ARRAY OF SOLID STATE COUNTERS WITH DELAY LINE PULSE SORTING. O. M. Bilaniuk, B. B. Marsh, A. K. Hamann, and J. C. Heurtley (Univ. of Rochester, N. Y.). Nuclear Instr. & Methods, 14: 63-70(Nov. 1961). (In English)

A matrix of twenty 2×12 mm^2 surface barrier counters was constructed for use in the image plane of a magnetic spectrometer. The outputs of individual crystals are displayed in predetermined channels of a 400-channel pulse height analyzer. This is done by connecting separate crystals to successive sections of a delay line and converting the time difference between signals arriving at the ends of the line into pulse heights. Procedures for producing reliable Ge-Au surface barriers and contacts and properties of such counters are discussed. Samples of data decoded are presented. (auth)

8936 STABILIZING A SCINTILLATION SPECTROMETER BY MEANS OF A LOW FREQUENCY MODULATED LIGHT SOURCE. H. J. Rijks (Reactor Instituut, Delft, Netherlands). Nuclear Instr. & Methods, 14: 76-8(Nov. 1961). (In English)

The variation in multiplication of a photomultiplier, even if high voltage and temperature are constant, makes it difficult to measure a gamma energy-spectrum accurately. A method of stabilizing the gain of a photomultiplier by means of a light source modulated by 50 cps main frequency, which is rather constant, is presented. A gain stabilization better than 1% in 24 hours is achieved. (auth)

8937 QUANTITATIVE MEASUREMENTS OF ION BEAM PROPERTIES. P. H. Rose, A. B. Wittkower, R. P. Bastide, and A. Galejs (High Voltage Engineering Corp., Burlington, Mass.). Nuclear Instr. & Methods, 14: 79-82 (Nov. 1961). (In English)

A device that can be used to determine the profile, position, and emittance of beams of charged or neutral particles is described. Results for a 10-kev hydrogen ion beam are reported. (L.N.N.)

8938 PORTABLE PULSE GENERATOR FOR TESTING. Thomas Friese (Hahn-Meitner-Institut für Kernforschung, Berlin). Nuclear Instr. & Methods, 14: 83-6 (Nov. 1961). (In German)

A small portable pulse generator was built for testing and calibrating radiation detection instruments. The thermal drift of eleven calibrated frequencies is less than 1% between 0 and 45°C. The pulse amplitude is adjustable continuously from 0 to ±10 v, the pulse duration is 1 μs. The compensation of the thermal frequency drift of the blocking oscillator is described. (auth)

8939 A MECHANISM OF THE PROPAGATION OF GEIGER DISCHARGE IN HALOGEN-QUENCHED G. M. COUNTERS. Juichi Akutsu (Inst. of Physical and Chemical Research, Tokyo). Nuclear Instr. & Methods, 14: 87-93(Nov. 1961). (In English)

A mechanism of the propagation of the Geiger discharge parallel to the anode wire, i.e., the cause of the successive avalanche following the first avalanche initiated by an ion-

izing particle in halogen counters, was studied theoretically. The results obtained elucidate that successive avalanches in argon-bromine counters are due to the secondary electrons produced in the gas but not the photoelectrons produced at the cathode, although the Geiger discharge is not confined to the region of the gas volume where the first avalanche is formed, and photons created in the avalanche can cause photoionization at some distance from the point of origin. This may account for the experimental results that the cathode does not play a part in the mechanism of argon-iodine counters. (auth)

8940 SINGLE SAMPLE SPIN GENERATOR SPECTROMETER. K. V. Vladimirskii (Vladimirsky) and B. A. Labzov (Lebedev Inst. of Physics, Moscow). Nuclear Instr. & Methods, 14: 94-6(Nov. 1961). (In English)

Resonance conditions in the high-resolution nuclear magnetic resonance spectrometer are stabilized by a self-excited electronic circuit, the frequency of oscillation being controlled by one of the lines of the sample under study. A very small width of this control line increases considerably the precision with which the frequency follows the unstable field. Changes in the magnet's field configuration do not influence the results of the chemical shift measurements because the same sample is used for both the stabilization and recording of the spectrum. (auth)

8941 ARGON ACTIVATION MEASURES IRRADIATION FLUX CONTINUOUSLY. Radford M. Carroll (Oak Ridge National Lab., Tenn.). Nucleonics, 20: No. 2, 42-3(Feb. 1962).

A method is described for using activation of flowing argon gas as a measure of neutron flux in an irradiation capsule. Since the reactor conditions do not change during the few seconds it takes argon to pass through the sample container, one can calculate the exposure flux easily. This method can be used for all values of neutron flux and is not restricted by burnup, temperature, or space limitations. An irradiation capsule is described that holds fuel test specimens being irradiated in a reactor. (N.W.R.)

8942 NEUTRON-ACTIVATED WIRES PLOT FLUXES IN YANKEE CORE. Andrew J. Kompanek, Jr. (Teleflex, Inc., North Wales, Penna.) and Edmund C. Tarnuzzer. Nucleonics, 20: No. 2, 44-6(Feb. 1962).

An activation-wire system for mapping neutron fluxes in the Yankee core is described. The wire system is part of the special in-core instrumentation, which also includes a network of 27 thermocouples that measure temperatures of outlet water. By activating steel wires in the core, Yankee operators verify calculations of power distribution, burnup, and best control-rod position so they can improve performance. Wire activation movement and counting can be controlled either manually or automatically. (N.W.R.)

8943 SEMICONDUCTOR MEASURES FLUXES IN OPERATING CORE. Vladimir Ajdacic, Milan Kurepa, and Branislav Lalovic (Boris Kidrich Inst. of Nuclear Sciences, Belgrad). Nucleonics, 20: No. 2, 47-9(Feb. 1962).

A Yugoslavian method for measuring neutron fluxes in a reactor core with a semiconductor detector is described. Since semiconductor detectors fail after exposure to an integrated neutron dose above 10^{13} n/cm^2, they have been impractical in reactors operating above several watts. However, this limitation may be overcome if the semiconductor is moved out of the reactor core and a long tube is extended into the core region with a fissionable target at the core end. The detector counts fission fragments from the target. Flux distribution can be plotted by moving the target and tube within the core. An illustration of the setup is shown in the 10 Mw reactor at Vincha. The method is compared with the compensated ion chamber and induced-activity methods. (N.W.R.)

8944 ION-CHAMBER SYSTEMS. Jay Forster (General Electric Co., San Jose, Calif.). Nucleonics, 20: No. 2, 50-1; 54(Feb. 1962).

An improved miniature-ion-chamber system for measuring neutron fluxes in the Dresden reactor is described. The array of miniature ion chambers provides a detailed picture of the distribution of power within the reactor core, enabling the operator to avoid local hot spots and optimize over-all core performance. The system continuously monitors the neutron flux within the core of the reactor. The system is composed of 16 detector assemblies, each containing four axially displaced fission chambers positioned in 16 modified fuel bundles dispersed radially in the core for optimum coverage. The sensitivity average of the system is 3.7×10^{-15} amp per n/cm^2/sec. Response begins at 1% of rated power and covers a range of 5×10^{11} to 10^{14} n/cm^2/sec. Initially, over-all system accuracy is estimated at ±10% in thermal power as indicated by the control-room meter for a full-scale reading of 280,000 Btu/hr-ft^2. (N.W.R.)

8945 NEUTRON TELESCOPE MONITORS LOCAL POWER DENSITY. Samuel Untermyer (General Electric Co., Palo Alto, Calif.). Nucleonics, 20: No. 2, 52-4(Feb. 1962).

A neutron detector (neutron telescope) external to the Vallecitos Boiling Water Reactor is described which monitors steam output in boiling-reactor channels by detecting changes in the uncollided neutron flux which reflect variations in local steam-void volume. The neutron telescope indicates the exit voids in the coolant above a channel by determining the attenuation of the uncollided neutron flux that leaves the reactor in a narrow or collimated beam. The neutron telescope setup is shown as it applies to the VBWR. Typical relations between reactor power, voids, and counting rates are graphically shown. (N.W.R.)

8946 HOW TO MAKE BLISTER-FREE URANIUM DETECTOR FOILS. Robert Gordon and Leroy Althouse (Univ. of California, Livermore). Nucleonics, 20: No. 2, 68(Feb. 1962).

To make small detector foils for irradiation measurements and subsequent beta or gamma counting, one can strip off the plastic coating and punch out small disks from large, thin metallic sheets of uranium (U^{235} or U^{238}) used for zero-power critical assemblies. Before they can be used, however, these disks must be sealed between covers to avoid contamination. A method is described for covering these uranium disks with ordinary household aluminum foil. During the procedure, it is found necessary to use a moisture-free adhesive to seal the aluminum foil to the uranium disks in order to prevent blistering. Although the bonds are sensitive to extreme temperature variations and impart little tensile strength, the detector foils remain blister-free and usable for more than a month. (N.W.R.)

8947 ACTIVATION ANALYSIS FOR PLANT STREAM MONITORING. Oswald U. Anders (Dow Chemical Co., Midland, Mich.). Nucleonics, 20: No. 2, 78-83(Feb. 1962).

The principles of operation, feasibility, flow diagrams, performance, and uses of a stream analyzer based on neutron activations of elements giving rise to short-lived activation products are described. It is shown that activation analysis can be used for such analyzers whenever it is possible to activate and count the desired stream constituent

in transit. Three experiments are given to prove the feasibility of the stream analyzer. (N.W.R.)

8948 THE AUTOMATIC COLLECTION AND REDUCTION OF DATA FOR NUCLEAR SPARK CHAMBERS. H. Gelernter (CERN, Geneva). Nuovo cimento (10), 22: 631-42(Nov. 1, 1961). (In English)

A system is described that dispenses with the use of photographic film for recording the data contained in the discharge of a nuclear spark chamber. Instead, the chamber itself is directly viewed by a television vidicon camera, whose output is digitized for direct input to a computer or for recording on magnetic tape. Preliminary experiments indicate that a measurement precision of 0.1% (i.e., location of the center of a spark to 1 mm in a meter-wide chamber) is easily attainable with ordinary industrial vidicon tubes. The existence of high resolution vidicons makes it likely that this figure can be substantially improved. By coupling the video system directly to an IBM 7090 computer, it is shown that the automatic collection and on-line analysis of 10^5 spark chamber events per day is probably feasible. (auth)

8949 THE DESIGN OF A SIMPLE URANIUM-THORIUM DISCRIMINATOR FOR WEAKLY ACTIVE ORES CONTAINING LESS THAN 1% U_3O_8 EQUIVALENT. PART II. DESIGN, USE AND TESTING OF DISCRIMINATOR. M. Khurshid Husain, Mohammad Azeem, and Mazhar M. Qurashi (Pakistan Council of Scientific and Industrial Research, Karachi). Pakistan J. Sci. and Ind. Research, 4: 93-6(July 1961). (In English)

The design, use, and testing of a simple uranium-thorium discriminator for weakly active ores containing less than 1% U_3O_8 equivalent are given. The information is primarily concerned with the design concepts used in constructing the discriminator for discriminating between uranium and thorium in approximate equilibrium with their decay products. (N.W.R.)

8950 CHARACTERISTICS OF THE SCINTILLATORS FOR A WHOLE BODY COUNTER. Masao Oshino, Satoru Ohtani, and Susumu Suguri (Japan Atomic Energy Research Inst., Tokyo). Radioisotopes (Tokyo), 10: 287-96 (Sept. 1961). (In Japanese)

Characteristics of sodium iodide crystal and plastic scintillators are investigated for use in whole-body counters. The backgrounds of a 5 in. diam by 4 in. NaI (Tl) crystal are 28809 cpm for an energy band from 60 to 1640 kev when the crystal is unshielded and 363 cpm when the crystal is shielded by 20 cm of steel and 3 cm of lead. The measured total efficiency is found to be consistent with the calculated total efficiency within experimental error. For the photo-peak efficiency the measured figure is much larger than the calculated figure, which is considered to be due to total energy absorption by multiple Compton scattering. The peak to total ratio of the crystal is measured for a source at different depths in a water phantom, and from this experiment the depth of radioisotopes in the human body may be estimated within an error of a few cm. The minimum detectable amount of radioisotopes is around 1 mμc. The results with plastic scintillators are as follows: The counting efficiency becomes larger as the size of the scintillator increases. The pulse height becomes smaller as the size increases. The background counting rate is nearly proportional to the surface area. Based on the results, 115 mm diam by 100 mm plastic scintillators are used for whole-body counting and locating radioisotopes in the human body. The measured counting efficiency of the plastic scintillators is consistent with the calculated figure. (N.W.R.)

8951 A NEUTRON DIFFRACTOMETER FOR A POOL REACTOR. H. E. Petch, W. Brouwer, B. H. Torrie, and I. D. Brown (McMaster Univ., Hamilton, Ont.). Research Reactor J., 1: No. 1, 8-12(Oct. 1960).

The neutron diffractometer and its associated equipment used for measuring patterns at the McMaster University pool reactor are described. The arrangement of the equipment is shown along with control and measuring circuits for the diffraction equipment. The performance of the equipment is described by means of diffraction peaks obtained from a single crystal of sodium chloride. (N.W.R.)

8952 DRIFT TUBE-MASS SPECTROMETER FOR STUDIES OF LOW-ENERGY ION-MOLECULE REACTIONS. E. W. McDaniel, D. W. Martin, and W. S. Barnes (Georgia Inst. of Tech., Atlanta). Rev. Sci. Instr., 33: 2-7 (Jan. 1962).

An apparatus was developed for the mass spectrographic study of ion-molecule reactions occurring under gas-kinetic conditions. Ions are produced by electron bombardment inside a long drift tube containing gas at a pressure of up to about 0.7 torr. The ions diffuse down the drift tube under the influence of a weak electric field. A sample of the ion population at the end of the drift tube is extracted through a two-stage, field-free differential pumping section and passed into a 60° magnetic deflection mass spectrometer. The number of ion-molecule collisions in the drift tube may be varied over a wide range by changing the source position and/or the gas pressure. Information concerning the nature and probability of the reactions occurring is revealed by the resulting changes in the ionic mass spectrum. (auth)

8953 LINE SHAPE IN MÖSSBAUER SPECTROSCOPY. Stanley L. Ruby and John M. Hicks (Westinghouse Electric Corp., East Pittsburgh, Penna.). Rev. Sci. Instr., 33: 27-30(Jan. 1962).

The line shape, amplitude as well as half-width, to be expected experimentally from a natural linewidth thin source and a natural linewidth Mössbauer absorber is computed as a function of the thickness of the absorber. The experimental result using stainless steel source and absorber and correcting for background has double the expected width, but nearly the correct fractional change in rate. This is compatible with a blurring due to dissimilar microenvironments of about ±0.10 mm/sec. (auth)

8954 RESOLVING-POWER MULTIPLIER FOR MASS SPECTROMETERS. B. R. F. Kendall (National Research Council, Ottawa). Rev. Sci. Instr., 33: 30-7(Jan. 1962).

A detailed description is given of a device which is capable of increasing the effective resolving power of a mass spectrometer. An improvement in resolution by a factor of eight is achieved. The design is based on a general analog technique for improving the resolution of analytical instruments. The device, which can be regarded as a resolving-power multiplier, consists of an electronic analog mass-spectrometer connected to memory and feedback circuits. Fully resolved spectra are displayed on the screen of an oscilloscope. Information sufficient for the design, construction, adjustment, and operation of similar systems is given. Results obtained with experimental resolving-power multipliers are described. (auth)

8955 PROPERTIES OF LEAD THERMAL SWITCHES AT LOW TEMPERATURES. William Reese and William A. Steyert, Jr. (Univ. of Illinois, Urbana). Rev. Sci. Instr., 33: 43-7(Jan. 1962).

The electrical resistivity of polycrystalline lead and the resistance of soldered contacts to the lead were measured at 1.16 and 4.2°K in magnetic fields up to 7000 gauss. The

thermal conductance of a simple lead heat switch was measured in both the normal and the superconducting states in fields up to 3000 gauss in the temperature range of 0.15 to 0.5°K. Assuming the best linear fit for the temperature dependence for the conductivity of the normal state, the ratio of the thermal conductance of the switch (lead plus contacts) in the 3000-gauss normal state to that of the superconducting state was found to be $(T/K°)^{-2.3}$, however, the numerical factor varied strongly with magnitude and orientation of the field. As a magnetic field was slowly removed from the superconducting lead, heating corresponding to the irreversible exit of trapped flux was observed. The design of lead thermal switches is discussed. (auth)

8956 REMOVAL OF HIGHER ORDERS IN THE THERMAL REGION FOR A NEUTRON CRYSTAL SPECTROMETER. V. P. Duggall and C. L. Thaper (Atomic Energy Establishment, Trombay, India). Rev. Sci. Instr., 33: 49-50(Jan. 1962).

A Be single crystal filter was used to eliminate higher-order contamination in the thermal neutron energy range from the monochromatic beam of a single crystal neutron spectrometer employing Ge(111) as monochromator. It is shown that 6.4-cm Be crystal filter is sufficient to suppress higher order contamination to less than 0.5% in the neutron energy range ~0.02 to 0.06 ev and the attenuation of the primary beam is a factor of 2 to 3 in this energy range. (auth)

8957 MULTICHANNEL ANALYZER DATA ANALYSIS BY A LEAST SQUARES COMPUTER PROGRAM. P. McWilliams, W. S. Hall, and H. E. Wegner (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instr., 33: 70-3(Jan. 1962).

An analysis method for the output of a multichannel analyzer is described. The data are fitted by a least squares computer program that will determine the area under Gaussian distributions which may be only partially resolved or separated. Mathematical considerations are discussed. Examples of various fits are shown illustrating the capabilities and some of the operational difficulties involved. (auth)

8958 PARAMETERS AFFECTING THE PERFORMANCE OF LARGE LIQUID SCINTILLATION COUNTERS. Vernon N. Kerr, F. Newton Hayes, and Ernest C. Anderson (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instr., 33: 100-2(Jan. 1962).

The performance of large liquid scintillation counters as a function of counter size, photocathode area, solution transparency, and inner wall reflectivity is treated mathematically in an empirically derived equation. The use of the equation allows a degree of quantitation of the light output of the counter, and figures show the effect of varying parameters upon this light output. (auth)

8959 NONLINEARITY CORRECTION FOR X-RAY DETECTORS. Stanley Bernstein and Max Canon (General Electric Co., Milwaukee). Rev. Sci. Instr., 33: 112-14 (Jan. 1962).

An expression is developed whereby coincidence losses occurring in an x-ray spectrometer unit can be readily evaluated. Equivalent departures from linearity are given when the x-ray tube is operated at constant potential, full-wave, and half-wave rectified. A quantitative relationship is obtained between the apparent increase in the absorption factor (for a foil of a fixed thickness) at high counting rates and the peak operating voltage of the x-ray tube for a given element. (auth)

8960 DEVICE FOR AUTOMATIC LANGMUIR PROBE MEASUREMENTS. Alonzo Robinson and Donald D. Hollister (Plasmadyne Corp., Santa Ana, Calif.). Rev. Sci. Instr., 33: 125(Jan. 1962).

An automatic Langmuir probe recording device is described for expediting a survey of the electron density distribution in a steady state plasma. The device is described by showing the circuit design and explaining the circuit functions. The device reduced the time required to record probe data by two orders of magnitude. (N.W.R.)

8961 PHOTOGRAPHY OF NEUTRON DIFFRACTION PATTERNS. S. P. Wang, C. G. Shull, and W. C. Phillips (Massachusetts Inst. of Tech., Cambridge). Rev. Sci. Instr., 33: 126-8(Jan. 1962).

Photography of slow neutron radiation can be accomplished through use of fluorescent screens in which secondary radiation (beta particles, gamma rays, or visible light) is used to produce photographic action. Thus, as part of a comprehensive study on screen-film combinations, a study is made of the sensitivity and spatial resolution of Li^6 metal-zinc sulfide systems and Li^6F-ZnS systems in various forms of combination. Hence, the relative neutron exposures required for the different screens to produce a photographic density of 0.5 on Tri-X film with monochromatic neutrons of wavelength 1.5 A are tabulated. It is seen that the homogeneously-mixed screen is more sensitive by an order of magnitude than the heterogeneous screens. Results are also given which show the screen response as a function of mixing ratio (ZnS to Li^6F) for different neutron wavelengths and an optimum weight ratio of about 4 is suggested. (N.W.R.)

8962 USE OF POLAROID FILM IN NEUTRON AND X-RAY DIFFRACTION. H. G. Smith (Oak Ridge National Lab., Tenn.). Rev. Sci. Instr., 33: 128-9(Jan. 1962).

A method and device employing the use of Polaroid film (high speed ASA 3000) are described for recording neutron and x-ray diffraction patterns. The device records patterns of both single crystals and powder specimens, and also investigates the centering of the sample in the neutron beam as well as the uniformity of the beam from the monochromator. Several photographs are presented to show patterns obtained by this method. The method is about twice as fast as conventional methods, and the development time is only 10 sec. (N.W.R.)

8963 IMPROVEMENTS IN OR RELATING TO PULSE GENERATORS. George Brian Barrie Chaplin and Alwyn Roberts Owens (to United Kingdom Atomic Energy Authority). British Patent 887,591. Jan. 17, 1962.

A pulse generator circuit is designed for generating pulses with a short rise time, controllable amplitude, and prolonged duration. (D.L.C.)

8964 IMPROVEMENTS IN OR RELATING TO CIRCUIT ARRANGEMENTS FOR RADIATION DETECTORS. Wolfgang Schonborn and Gunter Dorfel (to Veb Vacutronik). British Patent 887,781. Jan. 24, 1962.

A compensation circuit is designed to reduce the effect of temperature variation on the measurement of a density and/or thickness radiation gage. In this circuit, a comparison voltage provided by a reference source is varied automatically with variations in the ambient temperature. (D.L.C.)

8965 IMPROVEMENTS IN OR RELATING TO THE METHOD OF GAMMA COMPENSATION IN NEUTRON SENSITIVE IONISATION CHAMBERS. Alan Lyle Gray (to Plessey Co. Ltd.). British Patent 888,879. Feb. 7, 1962.

A neutron-sensitive ionization chamber is designed with an electrode structure so constructed that the gamma

compensation ratio can be adjusted to an optimum. The electrode structure comprises three tubular conical electrodes axially movable relative to each other to adjust the gamma compensation ratio. (D.L.C.)

8966 IMPROVEMENTS IN OR RELATING TO PHASE-SENSITIVE ELECTRIC RELAYS. Donald Harrison and Denis Harold Edwards (to United Kingdom Atomic Energy Authority). British Patent 888,889. Feb. 7, 1962.

A phase-sensitive a-c relay is designed for positive closing and opening of contacts. The relay comprises a cylindrical stator having a two-phase winding distributed in axial slots therearound, a cylindrical rotor coaxial within the stator, contact means operable by rotor rotation, and spring-loading means for restoring the rotor to an initial position. The winding consists of a high-impedance signal winding and a low-impedance reference winding. (D.L.C.)

8967 IMPROVEMENTS IN OR RELATING TO PULSE AMPLITUDE DISCRIMINATING CIRCUITS. George Brain Barrie Chaplin and Alwyn Roberts Owens (to United Kingdom Atomic Energy Authority). British Patent 888,894. Feb. 7, 1962.

A pulse amplitude discriminating circuit is designed which has improved stability with respect to the minimum pulse amplitude which it will accept. The circuit includes a pulse amplitude discriminator and has a stabilizing circuit comprising means for feeding in input pulses of standard amplitude, gate means for selecting the output pulses resulting from the input pulses, means for using the selected output pulses to adjust the circuit to accept pulses of the standard amplitude only, and means for inhibiting the selected output pulses from reaching the output terminal of the circuit. The circuit may be used to control the top channel of a multi-channel analyzer of the amplitude-to-time conversion type and for stabilizing time intervals. (D.L.C.)

8968 IMPROVEMENTS IN DEVICES FOR DETECTING RADIOACTIVITY. (to Philips Electrical Industries Ltd.). British Patent 888,959. Feb. 7, 1962.

A device is designed for detecting radioactive particles in a gas. The device comprises a Geiger counter tube having a central channel for passing a gas through and an electrostatic precipitator formed by a thin conductive wire in the channel. (D.L.C.)

8969 DIGITAL Q METER. William L. Briscoe (to U. S. Atomic Energy Commission). U. S. Patent 3,020,750. Feb. 13, 1962.

A digital Q meter is described for measuring the Q of mechanical or electrical devices. The meter comprises in combination a transducer coupled to an input amplifier, and an upper and lower level discriminator coupled to the amplifier and having their outputs coupled to an anticoincidence gate. The output of the gate is connected to a scaler. The lower level discriminator is adjusted to a threshold level of 36.8 percent of the operating threshold level of the upper level discriminator. (AEC)

8970 FLOWMETER. G. S. November and F. Schute (to U. S. Atomic Energy Commission). U. S. Patent 3,021,708. Feb. 20, 1962.

A fluid flowmeter is designed in which a standing pressure wave is established. The amplitude of this standing wave is a function of the fluid flow rate so that pressure sensing devices may be used to indicate fluid flow and variations thereof. (AEC)

Materials Testing

8971 (AGN-3059) CONSTRUCTION AND EVALUATION OF A DYNAMIC CREEP TEST MACHINE. Final Report. R. S. Carey (Aerojet-General Nucleonics, San Ramon, Calif.). Dec. 1959. Contract AT(04-3)-251. 38p.

Work was carried out on the centrifugal creep test principle. A simple, minimum cost, dynamic creep test machine was designed and constructed. The machine's usefulness for alloy development and materials screening for the USAEC Reactor Program was evaluated. Simple sheared sheet specimens were first tested, followed by machined specimens. Operation of the machine requires attaching sheet specimens to the test fixture, which is then rotated to apply a bending force to the specimens. This force is applied as that of a uniformly loaded beam and causes a fiber stress in the sheet specimen that can be easily calculated. The stress can be varied by changing the speed of rotation. This enables stress history to be programmed into the test to simulate the stress history of a working part. These tests proved that the dynamic creep test machine is a useful screening device for metals and alloys. (auth)

8972 (CRRL-1054) DEVELOPMENT AND OPERATION OF A CREEP TEST MACHINE FOR THE NRX REACTOR. C. E. L. Hunt (Atomic Energy of Canada Ltd., Chalk River, Ont.). Aug. 1961. 16p. (AECL-1386)

The instrumentation and development of the first in-pile creep facility for NRX is described, and some of the operating problems are discussed. (auth)

8973 (DLCS-1650102) STEADY STATE LOAD TESTS. Test Results T-554927. (Duquesne Light Co., Shippingport, Penna.). First issue, May 26, 1961. 48p.

Tests were performed to obtain station performance data at various steady-state generator loads. The station was operated for four-hour periods at steady state conditions and levels of 5, 21, 42, and 61 Mw gross generator output. The various readings are presented in tabular form. A list is given of equipment in service during the test. All plant components operated satisfactorily during the test. (M.C.G.)

8974 (HW-64788) STATUS REPORT ON THE HANFORD DEVELOPED TESTER FOR THE COEXTRUDED FUEL ELEMENTS. T. G. Lambert (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 13, 1960. 16p. Contract [AT(45-1)-1350].

A description is given of the development and evaluation of the electronic instrumentation and mechanical scanning equipment for checking coextruded fuel elements for clad thickness, clad integrity, bond, and core integrity. Eddy currents are used in the cladding tests, and ultrasonic methods are used in the other testing procedures. Cladding thickness tests show an accuracy of ±2 mils for an average wall thickness of 0.020 in. Ultrasonic tests indicate that the equipment will provide adequate nondestructive quality control in the areas of its design, but additional instrumentation are required for complete quality assurances. The nondestructive testing program is being expanded to cover billets and welds. (B.O.G.)

8975 (SCR-267) UNIFORMITY IN SHOCK TESTING. E. H. Copeland and W. J. Sieger (Sandia Corp., Albuquerque, N. Mex.). Dec. 1961. Contract [AT(29-1)-789]. 23p.

Presented at The National Meeting of the Institute of Environmental Sciences, Washington, D. C., April 1961.

The use of shock spectra techniques for the measurement and control of uniformity in shock testing was studied.

Shock pulses at several levels and durations from three laboratory shock machines were compared using spectra analysis. By extending the shock spectrum analysis to include multidegree-of-freedom systems instead of only single-degree-of-freedom systems, it was concluded that shock spectra techniques do not offer a practical method of measurement and control of uniformity in shock testing. These techniques can be used in some circumstances for correcting for deviations in wave shapes inherent in a particular machine. (auth)

8976 (CRGM-1034) THOUGHTS ON THE EXTRAPOLATION IN STRESS-RUPTURE EXPERIMENTS. Gerhard Krueger. Translated by A. Sawatzky and L. G. Bell (Atomic Energy of Canada Ltd., Chalk River, Ont.) from Neue Hütte, 5: No. 8, 481-7(Aug. 1960). 21p. (AECL-1324)

The scatter of experimental results are studied in their relationship to permitted tolerance in the load and test temperature as well as the inhomogeneity of the material. The scatter of the experimental results, the permitted scatter of extrapolated average values, and the test-times were found to be related to the necessary number of tests and total test time. σ vs. log t plots are better for extrapolating from than are log σ vs. log t, and conclusions can be drawn from these plots on stress-rupture testing. Many 5000-hr tests are more economical than fewer 10,000-hr tests. Metallographic considerations in connection with the semi-log plots were shown to aid in the reliability of the extrapolation. (auth)

8977 CHECKING DISTRIBUTION OF URANIUM-235 IN NRU ENRICHED RODS. A. D. McEachern (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. Nuclear Technol., 25-8(Winter 1962).

An automatic scanner is described for checking uniform distribution of uranium-235 in the enriched fuel rods of the NRU Reactor. The scanning equipment consists of a lead housing, positioning mechanism, control circuit, count-rate recorder, monitor recorder, and various connecting mechanism. The scanning results are punched on a perforated paper tape which can be used as input to a Royal McBee LGP-30 computer. The computer is programmed to print only results that fall outside a preselected range. The uranium-235 is measured by counting the gamma rays that result from natural decay in the narrow band around 184 kev. (N.W.R.)

8978 CRACK ARREST TESTS ON REACTOR PRESSURE VESSEL STEELS. A. Cowan and H. G. Vaughan (Culcheth Labs., Culcheth, Lancs, Eng.). Nuclear Eng., 7: 57-60(Feb. 1962).

The method used to carry out crack arrest tests on steels is described. The method consists of holding a plate under conditions of constant tensile load while a brittle crack is artificially initiated at one end and allowed to travel into the plate, which may contain a temperature gradient or be at constant temperature. The assessment and application of isothermal test data is discussed with reference to values given by typical reactor quality plate. (N.W.R.)

8979 A 4,000 TON CRACK TESTING MACHINE. Byron Winder (Vickers-Armstrongs (Engineers) Ltd., [London]). Nuclear Eng., 7: 61-3(Feb. 1962).

A 4000 ton crack testing machine, which is to be used for carrying out brittle fracture and related tests on full-scale reactor pressure vessel plates, is described. The machine may take specimens of up to 4 in. thick. When under test load, a pulsator unit stretches the test specimen at a frequency of 10 c/min to induce stresses ranging from approximately 2 to 5 ton/in^2. The hydraulic system is described in detail. (N.W.R.)

8980 TESTING THICK PLATES FOR BRITTLE FRACTURE. A. A. Wells (British Welding Research Assn., [London]). Nuclear Eng., 7: 64-6(Feb. 1962).

The equipment and method used for testing thick plates for brittle fracture by applying low tensile stresses are described. The equipment and method may also be used for testing nozzle specimens of reactor pressure vessels. The material is tested in its full thickness; it is welded in such a way that the residual stresses and concomitants are favorable to fracture, and an artificial defect is associated with the weld. Under these conditions fractures are obtained at low, slowly applied tensile stresses, and with the minimum of departure from conditions that could plausibly arise in fabrication or service. A realistic assessment can then be claimed for such features as stress relief and overload before service. Examples are given of tests made using the method and equipment described. The equipment is only briefly described by its characteristics. (N.W.R.)

8981 AUTOMATIC CONTROL PROBLEMS ON NUCLEAR FUEL ELEMENT RAPID THERMAL CYCLING RIGS. W. A. Havranek. Process Control and Automation, 8: 290-6(July 1961).

Following a short introduction on analog computer uses in control systems and a short description of thermal cycling rigs in reactor engineering, the features of a computer control system for thermal cycling rigs are described. The need for a precise analog computer control system is explained and the solution to the problems of automatic control is given. Attention is drawn to similar applications which could arise in other industries. Flow and circuit diagrams are presented of the computing equipment which is designed to control the physical conditions of the fuel element specimens accurately, instantaneously, and without manual attention. (N.W.R.)

8982 INVESTIGATION OF THE MECHANISM OF WEAR OF WIRE DRAWING DIES BY THE RADIOACTIVE TRACER METHOD. P. F. Groshev. Tsvetnye Metally, 34: No. 3, 71-5(1961).

An investigation was made to establish whether the distribution of the products of die wear follows a definite law, and to find out how it is affected by the variation of the drawing speed. The drawing experiments were carried out on a special drawing machine in which provision was made for coiling the wire in such a manner that the consecutive turns did not touch. It was found that at slow drawing speeds (about 30 m/min) approximately 75% of the products of wear adhered to the wire, the remaining 25% being carried away by the lubricant. As the drawing speed increases, the ratio changes quite rapidly and, beginning at a drawing speed of about 120 m/min, remains constant, the relative proportion of the wear products on the wire and in the lubricant being 92 and 8%, respectively. The observed effect of drawing speed is attributed to the fact that at high drawing speeds more lubricant adhering to the wire is drawn through the die. The relative proportion of the eroded die particles, accumulated on the surface of the coiling drum, amounted (at the drawing speed employed) to 4 to 8%. It was also indicated that the adhesion of the eroded die particles to the wire surface depends on the nature of the lubricant used. Results also showed that the wear products are not uniformly distributed along the wire, the eroded die material being present in the form of small uniformly distributed particles,

single tungsten carbide grains, and aggregates of tungsten carbide grains. (P.C.H.)

8983 PRODUCTION OF URANIUM TETRAFLUORIDE. R. J. Allen and H. G. Petrow (to U. S. Atomic Energy Commission). U. S. Patent 3,023,078. Feb. 27, 1962.

A process is given for preparing uranium tetrafluoride from an acid solution of a uranyl salt containing chloride ions. The process comprises adding cupric ions and fluoride ions thereto, heating the solution to 80 to 95°C, reducing the solution with either sulfur dioxide, ascorbic acid, hydroxylamine hydrochloride, or hydrazine sulfate, and recovering the resulting uranium tetrafluoride precipitate. (AEC)

GEOLOGY, MINERALOGY, AND METEOROLOGY

8984 (AD-263069) APPLICATION OF WEATHER RADAR TO FALLOUT PREDICTION. Quarterly Technical Report No. 13, March 1, 1961 through May 31, 1961. Pauline M. Austin (Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology). June 15, 1961. Contract DA 36-039-SC-75030. 20p.

Excellent data have been obtained during the past quarter on a variety of weather situations ranging from snowstorms in March to hail and thunderstorms in May. Signal intensity contours on both radars, RHI photographs, R-meter measurements and radiosonde soundings have been made. Work has been resumed on designing and building a sweep integrator for use with short pulse on the AN/CPS-9 radar. It is probable that frequency modulation rather than amplitude modulation will be employed. A tipping-bucket rain gage has been built to operate on the outflow of the Hudson-Jardi gage and thus monitor its operation. The rainfall data have been greatly improved by this addition. The data reduction program and the analysis of storm structure are progressing satisfactorily. The computations on modification of fallout patterns by rain have been slowed down by computer and program failures. Work is continuing, however, and it is hoped that these difficulties will be solved shortly. (auth)

8985 (CEA-2069) ETUDE PRELIMINAIRE DES RELATIONS URANIUM-MATIERES ORGANIQUES DANS LE GISEMENT DE L'HERAULT. (Preliminary Study of the Uranium-Organic Matter Relationship in the Herault Deposits). F. Chantret and R. Pouget (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). 1961. 19p.

The study of the coals and bitumens is carried out with the help of chemical and thermal analyses (thermogravimetry and differential thermal analysis). The U-organic matter and U–Mo, Pb relationships are defined. In the case of organic matter bound to the rock, it is found that the uranium enrichment is greatest when the carbon:organic matter is close to 0.5. Using thermal analysis, it is possible to distinguish different types of bitumen. Furthermore, the uranium concentration is highest in bitumens whose C/H ratio is 28. Certain exceptions show the existence of modification phenomena leading to new types of organic matter. The uranium occurs in the bitumens very likely in the form of organometallic complexes. (auth)

8986 (CEA-NOTE-352) ETUDE SUR LES ACCELERATEURS DE PARTICULES, DU TYPE TRANSPORTABLE, UTILISES EN TANT QUE SOURCES DE NEUTRONS. APPLICATIONS A LA PROSPECTION PETROLIERE. (Study on Particle Accelerators of Transportable Type, Utilized as a Neutron Source. Applications to Petroleum Prospecting). S. Godar (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 71p.

Drill-hole logging methods that utilize radioactivity are classified and examined. The methods studied are based on: detection of natural radioactivity (gamma logging); scattering of the γ rays from a radioactive source (gamma-gamma logging); thermalization of neutrons from a fast-neutron source (neutron logging); detection of capture γ rays produced in nuclear reactions engendered by neutron sources (Ra–Be, Po–Be, Pu–Be, etc., or portable electrostatic generators, specially adapted to neutron production); or detection of the artificial radioactivity induced in geological formations by neutron sources. Particular attention is given to the details of the neutron sources used. The interpretation of the data from these logging methods is discussed. (T.F.H.)

8987 (FZM-2029) DETERMINING EXTERNAL DOSE FROM THE PASSAGE OF A RADIOACTIVE CLOUD. J. C. Couchman (Convair, Fort Worth, Tex.). Dec. 7, 1960. 25p.

Paper presented at the Winter Meeting of the American Nuclear Society, December 11-15, 1960, San Francisco.

Numerical techniques that were programmed to compute external gamma dose from the passage of a radioactive cloud are described. The results of a number of typical problems are included. The elliptical integral equation used to obtain the dose is given. The method was set up as an IBM-704 computer code with the cloud divided into 160 equal-activity areas. The dose rate is computed for 43 cloud positions including one in the plane of the receptor. (M.C.G.)

8988 (FZM-2276) APPLYING THE RESULTS FROM FIELD DIFFUSION STUDIES TO PREDICT THE ATMOSPHERIC DISPERSAL OF EFFLUENTS. J. C. Couchman (Convair, Fort Worth, Tex.). June 13, 1961. 35p.

Paper presented to the American Meteorological Society Meeting, Davis, California, June 20-22, 1961.

The results of six, well-documented field diffusion studies were processed by a digital-computer program to determine curve-fit diffusion parameters. The diffusion parameters were fitted for the generalized form of the atmospheric diffusion equation that was suggested by B. P. Leonard. This method produced agreement in parameter values between different diffusion experiments. Also, the use of the average lapse and inversion parameters in predicting atmospheric dispersal over smooth and rugged terrain at various experiment sites is discussed. Some of the important findings from these studies that may be of interest in designing new diffusion experiments are presented. (auth)

8989 (FZM-2278(Rev.A)) EMPIRICAL CORRELATIONS OF ATMOSPHERIC DISPERSAL DATA. R. L. Seale and J. C. Couchman (Convair, Fort Worth, Tex.). June 13, 1961. 33p.

Presented to the American Meteorological Society Meeting, Davis, California, June 20-22, 1961.

Empirical correlation of over 100 experiments on atmospheric dispersal was analyzed to obtain a systematic set of diffusion parameters. Techniques used included least-squares fits to centerline concentrations and to the lateral Gaussian shape of the concentration curves. The statistical diffusion equation, stability parameter, diurnal variation of parameters, correlation of parameter values with measured meteorological conditions, analysis of measured and calculated air concentrations, analysis of measured and predicted isopleth areas, and concentrations and isopleth areas using fitted parameters are discussed. (M.C.G.)

8990 (IA-670) TRANSPORT AND DEPOSITION OF STRATOSPHERIC FALLOUT. J. Gilat (Israel. Atomic Energy Commission, Tel Aviv and Weizmann Inst. of Science, Rehovoth, Israel). June 1961. 44p.

Thesis submitted to Hebrew Univ., Jerusalem.

A general equation for the vertical transport of nuclear debris particles in the stratosphere is derived and solved subject to some simplifying approximations. Some esti-

mates of the horizontal transport are also made. The various assumptions and limitations are discussed and the solution is represented graphically and compared with experimental evidence on fallout. There is a good semi-quantitative agreement; features of observed fallout distribution are accounted for satisfactorily. Lack of meteorological data and especially of detailed initial nuclear cloud data does not permit a full quantitative calculation. The evidence that can be inferred from fallout measurements on the nature and structure of the lower stratospheric circulation is discussed. (auth)

8991 (NASA-TN-D-1098) THE SIMULTANEOUS MEASUREMENT OF IONOSPHERIC ELECTRON DENSITIES BY CW PROPAGATION AND RF IMPEDANCE PROBE TECHNIQUES. J. A. Kane, J. E. Jackson, and H. A. Whale (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). Jan. 1962. 22p.

The Aerobee-Hi rocket NASA 4.07 obtained vertical electron density profiles in the ionosphere simultaneously by the Seddon CW propagation technique and by an r-f impedance probe technique. The experimental goal was to assess the performance of the r-f probe against the accurate values from the CW method. In the r-f probe method, the electron density N was derived from the dielectric constant K of the medium at a frequency f = 7.75 Mc. If the earth's magnetic field is neglected, the relation between these quantities may be given as $K = 1 - (81\ N/f^2)$. The fractional error introduced by neglecting the earth's field is of the order of $(f_H/f)^2$ where f_H is the electron gyrofrequency. It was concluded that, with allowance for the positive ion sheath around the rocket, the r-f impedance probe can yield reliable values of electron density. These values were obtained from changes in the capacitive part of the probe's impedance. Small, apparently anomalous changes in the resistive part were also observed. (auth)

8992 (TEI-804) SELECTED LOGS AND DRILLING RECORDS OF WELLS AND TEST HOLES DRILLED AT THE NEVADA TEST SITE PRIOR TO 1960. John E. Moore (Geological Survey, Washington, D. C.). Jan. 1962. 59p.

A compilation of lithologic logs, drillers' logs, drilling records, and hydrologic data is presented for 18 wells and test holes drilled in the Nevada Test Site and the surrounding area prior to 1960. (D.L.C.)

8993 (TID-14437) A LITERATURE SURVEY OF THE HYDROGRAPHY, BATHYMETRY AND FISHERIES OF THE ATLANTIC OCEAN UNDER THE ATLANTIC MISSILE RANGE WITH AN APPENDIX ON THE MONA ISLAND REGION. Reference No. 61-36. C. Godfrey Day (Woods Hole Oceanographic Institution, Mass.). Dec. 1961. Contract AT(30-1)-2656. 113p.

This survey attempts to coordinate the most recent published information which is pertinent to the ocean areas underlying the Atlantic missile range extending seaward from Cape Canaveral, Florida. Emphasis was placed on water composition and movements, on the structure and topography of the bottom, and on fishery resources, where these appear to be related to the question of the transport and diffusion of pollutants. Also included is some unpublished information. (auth)

8994 (AEC-tr-4627) TRACKING OF GROUND WATER MOVEMENT BY MEANS OF RADIOACTIVE ISOTOPES. Ede Vessey. Translated from Hidrol. Közlöny, 38: 338-42(1958). 16p. (Includes original, 5p.).

Methods for the determination of both direction and velocity of ground-water movement by means of radioisotopes are given. The methods are described, the results presented, and conclusions aimed at the determination of the kind of isotopes to be used in similar measurements are included. Guidance is furnished for investigations of the adsorption of soils, the ion-exchange effects of clay minerals, the radiation from active ions, and half lives. (auth)

8995 RADIOACTIVITY OF DRY PARTICULATE MATTER IN AN URBAN ATMOSPHERE. J. Rosinski and J. Stockham. Bull. Am. Meteorol. Soc., 42: 688-92(Oct. 1961).

The total β activity of dry atmospheric particles collected in Chicago, Ill., ranged from 8973 pc/100000 ft^3 of air in Dec. 1958 to 177 pc/100000 ft^3 in Nov. 1959. From July to Nov. 1959 the total β activity decreased from 6990 to 399 pc/g of particles, and the strontium-90 activity from 229 to 16 pc/g. The activity of 1 to 10 μ particles was related to the cube of the particle dia. in the summer and to the 4th power in the winter. It is postulated that the activity resulted from rainsoaking during the particles' residence on the earth's surface. It was found that nonradioactive particles produced by urban activity dilute various size fractions of radioactive debris to different degrees. (auth)

8996 SIGNIFICANCE OF THE FIRST HALF-TIME OF ATMOSPHERIC FALL-OUT. V. Santholzer (Charles Univ., Prague). Československ. časopis pro fysiku, A 11: 469-75(1961). (In Czech)

About 400 samples of fall-out were obtained during 1957 to 1960. Fifty-six were so active that it was possible to follow their decay. The first half lives of the fall-out varied from 9 to 200 days. The measured half lives correspond approximately to the schematic calendar succession of nuclear tests and confirm that a radioactive cloud from one nuclear test sometimes passed twice over the sampling station. (auth)

8997 RESULTS OF ATMOSPHERIC FALL-OUT MEASUREMENTS IN THE THIRD YEAR AFTER CESSATION OF NUCLEAR TESTS. V. Santholzer (Charles Univ., Prague). Československ. časopis pro fysiku, A 11: 476-9(1961). (In Czech)

Systematic measurements of atmospheric fall-out prove that the activity decrease did not begin before spring, 1959. Toward the end of 1959, the day median activity of the fall-out dropped to 0.03 mc/km^2. In Mar. 1960, an increase of the day activity to 1.93 mc/km^2 could be registered. The increase was temporary, and the day activity dropped to 0.05 mc/km^2 in July 1960. Toward the end of 1960, another decrease, to 0.02 mc/km^2, took place. This value persisted through Spring, 1961. The cumulative activity to Oct. 31, 1959, was 104 mc/km^2 and in the second year to Oct. 31, 1960, 14 mc/km^2. From Oct. 1, 1960 to Apr. 30, 1961, the cumulative activity was 2 mc/km^2. (auth)

8998 A STUDY ON AIRBORNE RADIOACTIVITY SURVEYING. Shun-ichi Sano. Chishitsu Chosasho Geppo, 11: 701-20(Nov. 1960). (In Japanese)

The results of airborne radioactivity surveys over a 90000 sq km area are described along with several applications to practical problems. The effect of terrain topography, atomospheric radioactive substance, and thin surface layer to the altitude correction of gamma ray intensity are mainly discussed. The analysis of anomalous gamma ray intensity and the selection of the interval of flight lines are only briefly discussed. The procedures and results of the experimental airborne surveys concerning the surveying over very rough terrain and the local survey by using twin-engine aircraft are given. (auth)

8999 GEOPHYSICAL PROSPECTING STUDIES OF URANIUM RESOURCES AT HIRASE MINE, GIFU PREFECTURE. Kihei Shibatō, Kumiji Iida, and Shun-ichi Sano. Chishitsu Chosasho Geppo, 11: 721-32(Nov. 1960). (In Japanese)

Geophysical prospecting studies for uranium minerals were made in Hirase molybdenite mine, Gifu prefecture in October 1957 and March 1958. In the adit level, the electrical anomalies of molybdenite veins were studied as a trial practice, and the veins were traced by the new electrical and radiometrical prospecting. The results of applied new prospecting methods were successfully finished. Electrical and radiometrical corings of two bore holes also were done. As the result, typical anomalies were detected at both holes by the spontaneous polarization method. In the surface, the expressions of anomalies of the veins were studied by the electrical prospecting methods. As the result, the typical spontaneous polarization anomaly was found in the liparite zone. Moreover, two or three small anomalies that will be caused by silicified zone were recognized. However, no anomalies of the ore veins were found in the surface. (auth)

9000 OCCURRENCE OF RADIOACTIVE MINERALS IN THE PEGMATITES OF THE OKU-TANGO DISTRICT, KYŌTO PREFECTURE. Kuman Haraguchi, Toshio Takeichi, Yūji Tsukawaki, and Tadao Takeuchi. Chishitsu Chosasho Geppo, 11: 733-42(Nov. 1960). (In Japanese)

Newly found uraninite-like minerals and uranium bearing reddish brown zircon were found in small ore-pockets of the Oro pegmatite. The uraninite-like mineral may be considered as a mineral of uraninite–thorianite series from the results of spectroanalysis and intensity of radioactivity measured. The reddish brown zircon shows a higher content of U_3O_8 than the dark brown zircon, already known as Oro-ishi (U_3O_8 3%). Detailed geological and radiometric studies for two important deposits in the Oro and Kobe areas were also made. A tongue-like or belt-shaped aplite runs in the pegmatite, and the uraninite always occurs as fine grains in small ore-pockets which are found in the pale reddish microcline parts. Radioactivity of these parts is extremely high. A count-map was projected about the northwestern slope of the Kobe pegmatite in which equicount lines were described. A portion of the white-colored microcline shows below 200 counts per minute, while that of the reddish-colored microcline is above 500 counts at least, occasionally up to 1000 or 2000 counts, in which Kobe-ishi and the other radioactive minerals are easily found. Radioactive minerals from the Oro and Kobe pegmatites are very small in amount, and are not workable. Many pegmatite and quartz veins are found in Naka-gun and its adjoining district. Geologically speaking, all pegmatites of this district are distributed in NW and NE directions, which coincide with tectonic lines such as directions of faults, dikes of andesite, and quartz porphyry or joints of granites. The parent rocks (biotite–granite), general characters of the pegmatites and radioactive minerals, and paragenesis of ore minerals and their alterations are described. (auth)

9001 RADIOACTIVE ANOMALIES IN EASTERN TSUYAMA, OKAYAMA PREFECTURE. Haruo Nagahama and Kazuo Hoshino. Chishitsu Chosasho Geppo, 11: 759-62(Nov. 1960). (In Japanese)

The Tsuyama basin consists of tertiary and quaternary sedimentary rocks and basal rocks such as Paleozoic, Mesozoic, volcanic and granitic ones occupy the surrounding mountains. Surface examination with a portable Geiger counter indicated no significant abnormal radioactivity. (auth)

9002 THE HISTORY OF THE HOLOCENE ERA IN FRANZ JOSEPH LAND. M. G. Grosval'd, A. L. Devirts, and E. I. Dobkina (Geographic Inst., Academy of Sciences, USSR and Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 141: 1175-8(Dec. 11, 1961). (In Russian)

Lignin samples taken from terraces of Franz Joseph Land were dated by C^{14} counting. The dates were found to be 4775 and 7445 years. The samples were taken at about the same level from islands separated by a distance of 200 km. It is concluded that the west and central parts of Franz Joseph Land belong to the Holocene period. If the rise of the archipelago is due to isostatic pressure to compensate for the pressure of an ice sheet, the average ice thickness can be calculated as 500 to 600 meters. The fauna deposits indicate that the island passages were free of ice 8000 years ago. Because of finds of the horns of deer, it is believed that the climate of the archipelago was warmer and the plant life richer 8000 years ago than it is now. About 2500 years later, the climate grew colder and the deer perished. It is felt that the data justify a fourth sub-division in the Holocene period. (TTT)

9003 RADIOACTIVITY IN THE RUHR AREA. II. ACCUMULATION OF RADIONUCLIDES IN BIOLOGICAL MATERIAL OF SURFACE WATERS AND IN SLUDGE. Wilhelm Bucksteeg and Friedrich Dietz. Gas- u. Wasserfach, 102: 774-8(July 1961).

Procedure and sampling methods for measuring radioactivity of water organisms are given. Results of determinations for total β-activity of 393 biological samples are shown graphically. Species are grouped, and approximate sampling locations are given. Total β-activity of biological material of 251 samples, taken at the in- and out-flow of 5 big reservoirs of the Ruhr area, are shown for 9 species. Included is a statistical graph of β-activity from 60 sludge samples obtained from sewage disposal plants. Results of total β-activity for sludges collected from river, reservoir, and sewage disposal plants are summarized graphically. It is concluded that it is possible to monitor waters and measure activities through biological materials. Plant and animal organisms show discrete levels of activity. The sludges of the sewage disposal plants showed decreasing β-activity. The activity of plant organism in the out-flow of reservoirs was generally higher compared to that of the in-flow. No activity could be traced to isotope users. With the exception of the activity of K^{40}, fission product contribution from fall-out could account for most of the β-activity. Table. 7 figures. 6 references. (Pub. Health Eng. Absts.)

9004 PRIMARY LEAD IN THE DEVIL'S CANYON METEORITE. T. J. Chow and C. C. Patterson (Scripps Institution of Oceanography, [La Jolla, Calif.] and California Inst. of Tech., Pasadena). Geokhimiya, No. 12, 1124-5(1961). (In Russian)

In view of the great importance of the isotopic composition of primary lead for determining the cosmologic age, the original measurements of the Devil's Canyon meteorite which was used for determining the age of the Earth (C. C. Patterson et al. Phys. Rev. 92, 1234 (1953)), were repeated on the 12-in. mass spectrograph of the California Institute of Technology. The Pb content of the troilite was obtained by isotopic dilution to $4 \cdot 10^{-4}$% resulting in the following accuracy of measurements: ±0.3% for the Pb^{206}/Pb^{204}, ±0.4% for the Pb^{207}/Pb^{204} and ±0.5% for the Pb^{208}/Pb^{204} ratios. The difference between the corrected data and the previously published results lies within the limits of experimental error. Meteorites not containing U may present a variation in their isotopic composition of Pb. (TTT)

9005 CONSIDERATIONS OF RADIOACTIVE FALLOUT IN LIVORNO (ITALY). L. Argiero, S. Manfredini, and G. Palmas (CAMEN, Leghorn). Health Phys., 7: Nos. 1 and 2, 121-3(Dec. 1961).

Radioactive fall-out was collected on a monthly basis at Livorno by means of a high-walled polyvinyl chloride pluviometer, periodically washed in distilled water. Many radioactive products were found to be present. The mass of measurements showed the prevalence of two groups: one of short half life of the order of 60 days, and one of long half life of the order of 2 years. The greatest increment to fall-out accumulated on the ground level occurred in January 1960 and had a value of 4.25 mc/km^2. Additions of 2.37 and 3 mc/km^2 were made in February and March, respectively, while the fall-out deposited during the remaining months was of about 1 mc/km^2 per month. The greatest increment in radioactivity in rain occurred during May, even though there was only one day of rain and a rainfall of 0.5 mm. (P.C.H.)

9006 A THEORY FOR CLOSE-IN FALLOUT FROM LAND-SURFACE NUCLEAR BURSTS. Albert D. Anderson. J. Meteorol., 18: 431-42(Aug. 1961).

Current fall-out-computation methods do not account for the early-time dynamics of the fall-out process. Therefore, the present theory was originated in the attempt to explain the mechanics of fall-out more completely. This theory is checked by developing from it a mathematical fall-out model for land-surface bursts (the D model) and then by using this model to predict fall-out properties for nuclear tests. From a comparison of the predictions with observed test data, it is concluded that the new theory, despite certain idealizations, is useful for fall-out computation. 4 tables. 7 figures. 17 references. (Journ. Meteorol.)

9007 RUBIDIUM–STRONTIUM CORRELATION OF THREE TEKTITES AND THEIR SUPPOSED SEDIMENTARY MATRICES. W. H. Pinson, Jr. and C. C. Schnetzler (Massachusetts Inst. of Tech., Cambridge). Nature, 193: 233-4(Jan. 20, 1962).

The hypothesis that tektites are the fusion products of the local material in which they are found was not upheld by rubidium–strontium correlation data nor $Sr^{87}:Sr^{86}$ ratios. The correlation tests were run on three pairs of tektites and their associated matrix material. The results did not indicate support of the hypothesis that tektites may be the fusion products of large meteoritic splashes. (M.C.G.)

9008 STUDIES IN RADIOACTIVE FALLOUT IN NEW ZEALAND. PART I. THE MEASUREMENT OF RADIO-CAESIUM, -STRONTIUM, -BARIUM, AND -CERIUM IN RAINWATER. G. S. McNaughton and R. N. Woodward. New Zealand J. Sci., 4: 523-33(Sept. 1961).

An analysis scheme which was used during the past year to determine Cs^{137}, Ce^{144}, Sr^{90}, and Ba^{140} in every rain at Lower Hutt, New Zealand, is presented. Rainwater was collected in a polythene tank containing carriers, and soluble kationic material absorbed by a Dowex 50 resin column. The above isotopes were separated by elution with 0.7 M HCl, 1.5 M ammonium lactate, and 4 M HCl. The cesium and cerium fractions were radiochemically purified before counting, the former with a gamma spectrometer and the latter with a low-background beta counter. The Sr^{90} and Ba^{140} were reabsorbed on ion exchange columns and their Yt^{90} and La^{140} daughters eluted with pH 3.8 ammonium citrate, precipitated with yttrium oxalate, and counted in a low-background counter. The recovery of each carrier was determined chemically. Inherent errors in the method due to counting statistics and decay of activity were equivalent to deposited activities of about 5, 0.2, 0.4, and 0.8 μc/sq. mile for Cs^{137}, Ce^{144}, Sr^{90}, and Ba^{140} respectively, at the 90% confidence level. (auth)

9009 THE MEASUREMENT OF RADIOACTIVITY ALPHA IN THE AIR OF SOME PLACES OF LOW SILESIA DISTRICT. Jan Wesołowski, Stanisław Gąsior, Kazimierz Michalski, and Waldemar Stępniewski (Univ. of Wrocław, Poland). Nukleonika, 6: 801-12(1961). (In English)

The results of measurements of alpha radioactivity in the air at Low Silesia District are given. The method of measurement and the construction of the apparatuses are described. (auth)

9010 RESEARCHES FOR NATURAL RADIOACTIVITY OF SOILS–DISTRIBUTION OF ALPHA RADIOACTIVITY IN SOIL PROFILES. Stanisława Zmysłowska and Simone Wilgain (Central School of Agronomy, Warsaw and Institut Interuniversitaire de Sciences Nucleaires, Brussels). Nukleonika, 6: 813-26(1961). (In French)

Thirteen profiles of soils were investigated. Techniques are described for measuring very low alpha radioactivity by scintillation methods with efficiencies 46.5 ± 1% for thin sources and 74.0 ± 2% for thick sources. Notable variations in the alpha radioactivity of different soil profiles were observed. It seems that total alpha radioactivity in profiles of podsolic soils increase in the iluvium level. Total alpha radioactivity of examined soil samples was observed in limits from 4.7×10^{-12} to 64.4×10^{-12} c/g of soil. The greatest activity was found in loam compositions. (auth)

9011 GAMMA SCINTILLATION SPECTROMETRY IN DETERMINATION OF TOTAL POTASSIUM IN SOILS. Stanisława Zmysłowska and Jean Brocas (Polish Academy of Sciences, Warsaw and Université Libre, Brussels). Nukleonika, 6: 827-36(1961). (In French)

Twenty-one samples of different soils were investigated. Control measurements by chemical methods were accomplished and details of the flame photometer method are discussed. In five cases, deviations of gamma spectrometry and chemical results exceed 25%. It is suggested that the radioactive equilibrium of the uranium and thorium family in the soil samples examined is disturbed. (auth)

9012 EQUILIBRIUM PARAMETERS OF Sr-90 IN SACLAY SOIL. P. Cohen and C. Gailledreau (Centre d'Etudes Nucléaires, Saclay, France). Soil Sci., 93: 124-38(Feb. 1962).

The equilibrium parameters of Sr^{90} in the presence of Ca, Na, K, and NH_4 were measured in the Saclay soil for each of these 4 pairs: Sr-Ca, Sr-Na, Sr-K, and Sr-NH_4. The Sr-adsorption mechanism was studied by comparison with a synthetic resin, which is a pure ion exchanger. A preliminary study of a system with three components, one of which is a tracer, is also described. (auth)

9013 RADIOACTIVITY IN THE SURFACE WATERS OF TEXAS. E. F. Golyna, W. R. Drynan, and D. F. Smallhorst. Southwest Water Works J., 43: No. 5, 31-5(Aug. 1961).

A statewide study of radioactivity of Texas surface waters was started in 1958. Natural radioactivity has always been present in surface waters; nuclear energy can supply much more. Small amounts of radioactivity were found in all Texas surface waters sampled. None were above current published standards. Natural ore deposits contribute in some cases. Fall-out and washout also contribute. Radioactive wastes from nuclear reactors do not contribute noticeably at present. Reservoirs are effective in reducing β and α in a stream, by settling of suspended solids, and decay. Ground waters for munici-

pal supply contain less than 10 $\mu\mu c/1$ of gross β. Some farm wells showed up to 400. 2 tables. 2 figures. 4 references. (Southwest Water Works Journ.)

9014 RADIOAKTIVE PARTIKEL. Kolloquium des "Sonderausschuss Radioaktivität" am 5. und 6. März 1959 in Bad Schwalbach. ((Colloquium on) Radioactive Particles). No. 12 of "Schriftenreihe des Bundesministers für Atomkernenergie und Wasserwirtschaft. Strahlenschutz." Brunswick, Gersbach & Sohn Verlag GmbH, 1959. 204p. DM 5.

A study was made of "hot particles," dust particles with a relatively high radioactivity, in order to clarify the question of their origin, transport, and concentration and to determine the possible danger to man. The following topics are discussed: origin, composition, and structure of hot particles; particle observation in Duisburg; particle abundance in 1957 and 1958 and its dependence on substances in the air; observation of radioactive particles in Erlanger; measurements of the activity of the hot particles in the air dust; spatial and time distributions of the air activity; the size and build-up of the hot particles; detection of the radioactive particles and investigation of their gamma spectra; measurements of the hot particles; investigation of the strongly active fission products; statistics of the radioactive particles; the transport of radioactive impurities in the atmosphere; relationship between the size of the radioactive particles and their separation from the atmosphere; micro-distribution of radium in the bones and its significance in the radiation burden; dose distribution in the environment of hot particles; physiological and anatomical factors for estimation of the radiobiological significance of the hot particles; and biological effects of inhaled radioactive materials. (M.C.G.)

9015 RESEARCHES ON METEORITES. Carleton B. Moore, ed. New York, John Wiley & Sons, Inc., 1962. 236p. $7.00.

Twelve papers are included; separate abstracts have been prepared for three. One paper was previously abstracted in NSA. The contributions represent a reasonable cross section of current research interests in meteoritics. Hence, the researches give a review and discussion of the current problems and the probable solutions to these problems by future research. Contributions are on deformation and thermal alterations of iron meteorites, metallurgy of iron meteorites, nuclear analysis of meteorites, mineralogical and petrological aspects of meteorites, origin and relationship to Earth, the importance of meteorite investigations, and the problems of specimen recovery and use. (N.W.R.)

9016 THE MEASUREMENT AND INTERPRETATION OF RARE GAS CONCENTRATIONS IN IRON METEORITES. Peter Signer and Alfred O. C. Nier (Univ. of Minnesota, Minneapolis). p.7-35 of "Researches on Meteorites." New York, John Wiley & Sons, Inc., 1962.

The concentrations of cosmogenic rare gas isotopes in more than 20 iron meteorites are given. The results are used to deduce information about exposure ages, the sizes of the irradiated bodies, and the location of the samples in the bodies. The rare gas isotopes of interest are helium-3, helium-4, neon-21, and argon-38. Various nuclide ratios are also given for 23 iron meteorites. (N.W.R.)

9017 CALCULATION OF PRODUCTION RATES OF SPECIFIC NUCLIDES IN IRON METEOROIDS. Parmatma S. Goel (Carnegie Inst. of Tech., Pittsburgh and Tata Inst. of Fundamental Research, Bombay). p.36-67 of "Researches on Meteorites." New York, John Wiley & Sons, Inc., 1962.

A correlation is presented of the production rates of cosmic-ray-produced radioisotopes in meteorites. The correlations are concerned with the absolute production rates in meteoroids, variations in production rates due to depth in a meteoroid, and variations in production rates due to size of the meteoroid. The results of the calculations of the production rates of specific radioisotopes in iron meteoroids are given and their applications to some problems in meteoritics as well as in cosmic radiation are discussed. (N.W.R.)

9018 CARBON-14 IN A STONE AND AN IRON. Parmatma S. Goel (Tata Inst. of Fundamental Research, Bombay) and Truman P. Kohman. p.100-6 of "Researches on Meteorites." New York, John Wiley & Sons, Inc., 1962.

The detection and measurement of cosmic-ray-produced carbon-14 in the chondrite meteorite Richardton and the iron meteorite Henbury are discussed. The results of the measurements together with some relevant information on the counters are tabularly presented. The Henbury carbon specific activity is about the same as that of contemporary terrestrial carbon, therefore the possibility can not be excluded that part or all of this carbon-14 is a result of contamination by non-meteoritic carbon, as by leakage of atmospheric carbon dioxide into the gas system. The Richardton carbon specific activity, however, is definitely too high to admit of the latter explanation. (N.W.R.)

9019 ÜBERWACHUNG DER RADIOAKTIVITÄT IN STABU-UND REGENNIEDERSCHLÄGEN. (Monitoring of Radioactivity in Dust and Rain Precipitation). W. Herbst and G. Wiesenack. No. 22 of "Schriftenreihe des Bundesministers für Atomkernenergie und Wasserwirtschaft. Strahlenschutz." Munich, Gersbach & Sohn Verlag, 1961. 93p. DM 6.

Measurements were made of the radioactivity in dust and rain from September, 1956 through 1960 in Munich, Berlin, Essen, Cologne, Hamburg, Hannover, and Mannheim. Methods used in the monitoring are described. Results are presented in graph and tabular form. (M.C.G.)

HEALTH AND SAFETY

Refer also to abstract 9120

9020 (AEET/HP/2) MAXIMUM PERMISSIBLE LEVELS OF SURFACE CONTAMINATION. S. Somasundaram, P. V. Hariharan, and A. K. Ganguly (India. Atomic Energy Establishment, Trombay). 1961. 21p.

Maximum permissible levels of radioactive contamination were derived for the laboratories of the Atomic Energy Establishment Trombay. A comparative study was made of data for the Atomic Energy Research Establishment, Harwell, and Oak Ridge National Laboratory, Tennessee. It is pointed out that Indian living conditions and habits differ considerably from those of westerners, and that ingestion rather than inhalation constitutes the greater hazard for a person working with radioactive materials. Data are appended on maximum permissible levels of surface contamination. (C.H.)

9021 (AEEW-R-62) THE WINFRITH DISTRICT GAMMA SURVEY. I. W. Cavell and C. O. Peabody (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England). Sept. 1961. 26p.

The District Gamma Survey carried out around the Atomic Energy Establishment, Winfrith since June, 1959 is described. Its organization, equipment, and techniques are discussed. The results obtained up to December 31, 1960 are given. (auth)

9022 (ANL-6302) DESIGN AND HAZARDS SUMMARY REPORT, BOILING REACTOR EXPERIMENT V (BORAX V). (Argonne National Lab., Ill.). May 1961. Contract W-31-109-Eng-38. 208p.

Design data for BORAX V are presented along with results of hazards evaluation studies. Consideration of the hazards associated with the operation of BORAX V was based on the following conditions: For normal steady-state power and experimental operation, the reactor and plant are adequately shielded and ventilated to allow personnel to be safely stationed in the turbine building and on the main floor of the reactor building. The control building is located one-half mile distant from the reactor building. For special, hazardous experiments, personnel are withdrawn from the reactor area. (M.C.G.)

9023 (CEA-2037) APPAREIL DE CONTROLE DE LA CONTAMINATION RADIOACTIVE DES DISPOSITIFS FILTRANTS ADAPTES SUR LES APPAREILS DE PROTECTION DES VOIES RESPIRATOIRES. (Control Apparatus for Radioactive Contamination of the Filtering Device Adapted on the Protection Apparatus of the Respiratory Tracts). S. Dujancourt and J. Roche (France. Commissariat à l'Énergie Atomique. Centre de Production de Plutonium de Marcoule, Chuscian). 1961. 13p.

The apparatus allows detection and localization of the radioactive contamination of the mask cartridge, for alpha, beta, and gamma radiations, concerning external contamination, and for beta and gamma radiations, concerning internal contamination. It consists of a lead coffin, in which the cartridge is inserted for control. Halogen counters are in contact with it. Operation conditions (Geiger or proportional) and their position in regard to the cartridge are controlled from outside. A scaler counts the pulses, given by the different counters. (auth)

9024 (CEX-62.01) TECHNICAL CONCEPT—OPERATION BREN. J. A. Auxier, F. W. Sanders, F. F. Haywood, J. H. Thorngate, and J. S. Cheka (Oak Ridge National Lab., Tenn.). Dec. 1961. Contract [W-7405-eng-26]. 20p.

The Oak Ridge National Laboratory (ORNL) Health Physics Research Reactor is to be attached to a hoist platform on a 1500-ft tower at the Nevada Test Site (NTS). The project is a continuation of the studies commenced in 1956 for evaluating the radiation doses of persons exposed to nuclear weapons, especially the residents of Hiroshima and Nagasaki, Japan. Measurements will be made of the energy, angular, and spatial distributions of the radiation from the reactor. Various shields, including facsimiles of Japanese houses typical of those in Hiroshima and Nagasaki in 1945, will be studied. Experimentation is scheduled for early 1962. (auth)

9025 (LA-2641) CONTROL OF SMALL RADIOACTIVE SOURCES BASED ON MAXIMUM PERMISSIBLE INTAKE OF RADIOACTIVE MATERIALS FROM SINGLE ACUTE EXPOSURES. James N. P. Lawrence, Jerome E. Dummer, and Morris J. Engelke (Los Alamos Scientific Lab., N. Mex.). Nov. 27, 1961. Contract W-7405-Eng-36. 13p.

For radiation-control purposes a source is defined in terms of maximum permissible intake for a single acute exposure (MPI). Results are presented of a calculation of MPI using the latest-known biological data and the currently acceptable levels of internal exposure. The minimum values of Category A sources (100 MPI's) for the isotopes for which biological and physical data are available are also tabulated. (auth)

9026 (NP-11306) SAFETY ASPECTS OF NUCLEAR PROPULSION OF MERCHANT SHIPS. D. R. Murray Smith, H. N. E. Whiteside, and A. C. Manson (Gt. Brit. Ministry of Transport). 15p.

Presented January 16, 1962, at Plymouth.

The special safety features necessary for the international operation of nuclear-powered merchant ships are discussed. The nature of nuclear hazards is outlined and the hull, machinery, and navigational aspects are described. Radiation effects, hull strength, marine hazards, fire, explosion, collision, stranding, the reactor and associated equipment, movement in ports and harbors, manning, and salvage are discussed. (M.C.G.)

9027 (ORNL-TM-139) CRITICALITY EXCURSION / OF NOVEMBER 10, 1961. Dixon Callihan (Oak Ridge National Lab., Tenn.). Feb. 13, 1962. Contract [W-7405-Eng-26]. 5p.

A criticality excursion occurred at the Oak Ridge Critical Experiments Laboratory on November 10, 1961 as enriched uranium metal, neutron reflected and moderated by hydrogen, was being assembled. It is estimated that the energy yield was between 10^{15} and 10^{16} fissions. There was no personnel exposure or property damage. Fission product contamination, both airborne and contained in the metal, decayed sufficiently overnight to allow unhindered continuation of the experiment. The excursion was caused by a too rapid approach of the two sections of uranium constituting the experiment. (auth)

9028 (TID-14377) FALLOUT FROM USSR 1961 NUCLEAR TESTS. Gordon M. Dunning (Division of Operational Safety, AEC). [1961]. 22p.

The 1961 USSR nuclear tests produced 120 megatons of

total energy yield, of which about 25 megatons was the result of fission. Since essentially all the detonations were air bursts, the fission products were scattered globally. Estimates are presented of the radiation exposure to residents of the U. S. from this fall-out material. Estimates indicate that the 70-year radiation doses to the bones of children born in 1962, resulting from all past nuclear tests, is about one-fiftieth of the Federal Radiation Council's guide for normal peacetime operations, and that about 40% of this amount was contributed by the 1961 USSR tests. The contributions of Sr^{90}, Cs^{137}, I^{131}, and radioactivity in the air to exposure levels are discussed. (C.H.)

9029 (TID-14772) SAVANNAH RIVER BIOLOGICAL SURVEY, SOUTH CAROLINA AND GEORGIA, MAY–JUNE AND AUGUST–SEPTEMBER 1960 FOR THE E. I. DU PONT DE NEMOURS AND COMPANY, SAVANNAH RIVER PLANT; (Academy of Natural Sciences, Philadelphia). Sept. 1961. Contract [AT(07-2)-1]. 142p.

The populations and distributions of algae, protozoan fauna, lower invertebrate fauna, insect fauna, and fish species were surveyed in the Savannah River in the vicinity of the Savannah River Plant, in the spring and again in the summer of 1960. The river water was also subjected to chemical analysis. The results were compared with the results of 1951-1952, 1955, and 1956 surveys. (T.F.H.)

9030 (TID-14776) MONTHLY AIR, WATER, MILK, AND FILM BADGE REPORT, DECEMBER 1961. Oliver R. Placak (Nevada Test Organization. Off-Site Radiological Safety Activities, AEC). Jan. 29, 1962. 19p.

The gross beta activity of air and water samples, the isotopic (I^{131}, $Ba^{140}-La^{140}$, Cs^{137}, Sr^{89}, and Sr^{90}) activity of milk, the isotopic (Ru^{103}, $Zr^{95}-Nb^{95}$, $Ba^{140}-La^{140}$, Ce^{141}, Sr^{89}, and Sr^{90}) activity of grass and hay, and the exposures of film badges are reported graphically for various sampling locations near the Nevada Test Site. (T.F.H.)

9031 (WT-1421) EVALUATION OF BURIED CONDUITS AS PERSONNEL SHELTERS. G. H. Albright, J. C. LeDoux, and R. A. Mitchell (Bureau of Yards and Docks and Naval Civil Engineering Lab., Port Hueneme, Calif.). July 14, 1960. Project 3.2 [of] OPERATION PLUMBBOB. 70p.

Supersedes ITR-1421.

Twelve large-diameter buried conduit sections of various shapes were tested in the 60- to 149-psi overpressure region of Burst Priscilla to make an empirical determination of the degree of personnel protection afforded by commercially available steel and concrete conduits at depths of burial of 5, 7.5, and 10 feet below grade. Essentially, it was desired to assure that Department of Defense Class I, 100-psi and comparable radiations, and Class II, 50-psi and comparable radiations, protection is afforded by use of such conduits of various configurations. Measurements were made of free-field overpressure at the ground surface above the structure; pressure inside the structures; acceleration of each structure; deflection of each structure; dust inside each structure; fragmentary missiles inside the concrete structures; and gamma and neutron radiation dose inside each structure. All buried conduit sections tested provided adequate Class I protection for the conditions under which the conduits were tested. Standard 8-foot concrete sewer pipe withstood 126-psi overpressure without significant damage, minor tension cracks observed; standard 10-gage corrugated-steel 8-foot circular conduit sections withstood 126-psi overpressure without significant damage; and standard 10-gage corrugated-steel cattle-pass conduits withstood 149-psi overpressure without significant damage. Durations of positive pressure were from 206 to 333 milliseconds. (auth)

9032 (WT-1422) EVALUATION OF BURIED CORRUGATED-STEEL ARCH STRUCTURES AND ASSOCIATED COMPONENTS. G. H. Albright, E. J. Beck, J. C. LeDoux, and R. A. Mitchell (Bureau of Yards and Docks and Naval Civil Engineering Lab., Port Hueneme, Calif.). Feb. 28, 1961. Project 3.3 [of] OPERATION PLUMBBOB. 107p.

Three underground corrugated-steel arch structures covered with 5 feet of earth were subjected to peak overpressures of 60 and 100 psi during Burst Priscilla at the Nevada Test Site. Essentially, it was desired to assure that Department of Defense Class II (50-psi overpressure and comparable radiations) protection is afforded by two types of 25-foot diameter, 180-degree corrugated-metal arches. Free-field overpressure was measured at the ground surface above the structures, along with pressure inside each structure, acceleration of the floor slab, arch deflection relative to the floor slab, and gamma and neutron radiation dose inside each structure. Dust was measured inside one structure. All arch structures provided adequate Class II protection for the conditions of the test. One arch structure, reinforced with steel arch ribs, withstood 100-psi overpressure (333-msec positive-phase duration) with no significant damage other than a cracked floor slab. A blast closure valve was tested in the ventilating system of one structure. Operation was satisfactory during the positive-pressure phase, but the valve leaked excessively during the negative-pressure phase. Prototype pits designed to partially shield emergency power generator sets against blast, missiles, and thermal radiation damage were tested to determine their adequacy. Damage assessment indicated significant but inadequate protection at the overpressures to which the generator sets were exposed. (auth)

9033 (AEC-tr-4440) PROCEDURE FOR REACTOR PLANT SITE SELECTION BASED ON NUCLEAR ASPECTS. Erich Stauber. Translation of "Standortwahl und Grösster Anzunehmender Unfall bei Reaktoranlagen." Sept. 1961. 30p.

Original also published in Atomkernenergie, 6: 165-70 (1961).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 20336.

9034 (NP-tr-847) IONIC FIRE-ALARMS. K. Pawlik. Translated by R. Bluhm (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Deut. Farben-Z., 14: 397-8(1960). 6p.

An alarm is described that can sense an impending fire before any visible smoke or high temperatures are produced. The alarm uses a flow ionization chamber in conjunction with an α-emitter. Air passing through the chamber is ionized by the α radiation and migrates to the electrodes, thus causing a current to flow. Gas particles produced in smoldering materials are heavier than normal air molecules, and thus have a longer "residence time" between the chamber electrodes than the air molecules. The reduction of chamber current caused by the presence of the heavier and slower-moving smoldering gases is used to trigger the alarm. (T.F.H.)

9035 RESIDUAL GAMMA RADIATION IN THE VICINITY OF NUCLEAR WEAPONS. C. Sharp Cook. Am. Scientist, 49: 399-409(Sept. 1961).

The nature of gamma radiation originating from residual radioactivity, both neutron induced and associated with fall-out, is reviewed. Neutron induced activities, whose gamma rays are determined by means of a pulse height analysis, result from neutron capture by the specific material exposed to the blast. With respect to radiation from fall-out, this exposure results from radioactive fis-

sion products released after bomb detonation. The amount of radiation and its spectral characteristics vary with the type of weapon, the conditions under which it was detonated, and the meteorological conditions prevailing at the time of impact. The radiation pattern that results is dependent upon the individual gamma energies and the nature of the surface on which the source is distributed. (Public Health Eng. Abstr., Vol. 42, No. 1-2.)

9036 STRONTIUM 90 IN FINNISH GRASS AND COW'S MILK. O. Paakkola, R. Naesaenen, D. Merten, and J. K. Miettinen (Univ. of Helsinki and Kiel Biochemical Inst., Helsinki). Ann. Acad. Sci. Fennicae, Ser. A, II, No. 101, 1-12(1960). (In English)

Investigations were made on possible variations in the Sr^{90} content of milk and grass in different parts of Finland and on the general level of Sr^{90} in milk from the region of highest milk production at the end of the summer season 1959. The Sr^{90} content of wide-area milk samples was found to vary from 7.9 to 9.8, the mean being 8.7 $\mu\mu c$ Sr^{90}/g Ca. The Sr^{90} content of milk samples from experimental farms varied from 3.6 to 11.6, the mean being 5.7 $\mu\mu c$ Sr^{90}/g Ca. This is significantly lower than the corresponding country-wide value for southeastern Finland. Discussion is given as to how the values for Sr^{90} content in milk in Finland compare to values for other countries. It was concluded that the Sr^{90} content of milk in southern Finland is slightly lower than in the other countries in northern and western Europe. The value obtained for the discrimination factor grass-milk was 0.048. (P.C.H.)

9037 CAESIUM 137 IN FINNISH GRASS AND COW'S MILK. Antti P. U. Vuorinen and Jorma K. Miettinen (Finland Inst. of Tech., Helsinki and Biochemical Inst., Helsinki). Ann. Acad. Sci. Fennicae, Ser. A, II, No. 102, 1-5(1960). (In English)

Cesium-137 contents were determined in grass and milk samples from Finland in 1959. The results show that milk contamination in southern Finland is of the same order as that of other countries with similar climatic conditions. Samples from northern Finland show higher contamination, which are comparable with the values from Wales. This is probably due to higher rainfall. No correlation is visible between the values of the Cs^{137}/Sr^{90} ratio in grass and in milk. The mean for the discrimination factor grass-milk to Cs^{137} was determined as 0.28. The data are tabulated. (P.C.H.)

9038 MEDICAL PRACTICE AT A NUCLEAR POWER REACTOR. Charles E. Parker and William T. Doran, Jr. (Army Engineer Research and Development Labs., Fort Belvoir, Va.). Arch. Environmental Health, 4: 196-201 (Feb. 1962).

Experiences of the radiation health program at the Army Nuclear Power Reactor, Fort Belvoir, Va., are presented. The radiation and exposure histories are discussed. A preventive medicine program is followed, and the specific use of the slit-lamp examination, blood studies, and whole-body counter are discussed. Statistics on the radiation exposure are presented, and comments about lesions of the lens of the eye are made. We feel that much of the hysterical attitude toward radiation can be eliminated through an adequate preventive medicine program. (auth)

9039 MEDICAL SUPERVISION OF EMPLOYEES IN THE ATOMIC ENERGY INDUSTRY. F. W. Meichen (United Kingdom Atomic Energy Authority, Springfields, Eng.). Atompraxis, 8: 24-6(Jan. 1962). (In English)

Standards used by the UKAEA in the medical classification of applicants for employment are discussed. The classification is based on a medical examination made prior to hiring. In addition, medical supervision in practice is established, using a uranium processing plant as an example. (auth)

9040 RADIATION FALLOUT AND ITS HEALTH IMPLICATIONS. R. D. Connor. Can. J. Public Health, 52: 333-7(Aug. 1961).

Discussion is given on the natural settling and decay patterns of fission products resulting from nuclear detonations. The effects of nature in reducing radioactive concentration levels, the relationship of fall-out effects to population with respect to the somatic and genetic considerations, and the possible need for re-evaluation of radiation effects is also indicated, particularly in the area of low level irradiation of general population. (Public Health Abstr., Vol. 42, No. 1-2.)

9041 STRONTIUM-90 LEVELS IN HUMAN MILK. A NINE-MONTH SURVEY IN TORONTO. John R. Brown and Anita A. Jarvis. Can. J. Public Health, 52: 463-6 (Nov. 1961).

9042 A MORE RELIABLE GAMMA SURVEY METER. Using a Geiger-Muller tube, A.E.C.L. has designed a new meter which offers big advantages where weak fields need to be surveyed. A. R. Jones (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. Nuclear Technol., 40-1 (Winter 1962).

A reliable gamma survey meter using a Geiger-Mueller tube is described for measuring weak fields. The circuit diagram, method of operation, and probe energy response are indicated. The meter is made to measure fields from 0.5 mr/h, one-fifth of the ICRP limit for continuous occupational exposure, to 2.5 r/h. The meter also detects, but does not measure low levels of beta-gamma contamination. (N.W.R.)

9043 RADIATION SAFETY AT CERN. Johan Baarli. CERN Courier, 2: 4-8(Jan. 1962). (In English)

Descriptions are given of the means adopted at CERN to ensure safety from radiation hazards, and discussion is given on their effectiveness. Radiation safety at the CERN site falls into two major categories according to whether the machines are operating. General radiation safety problems, apart from those closely concerned with the machines, are also met at CERN in connection with the use of radioactive sources for calibration and testing purposes, and also in connection with irradiated targets used for nuclear chemistry studies. In addition, there is the control of radiation exposed personnel, which forms an important part of the CERN radiation safety activities. (P.C.H.)

9044 MAXIMUM PERMISSIBLE LEVEL OF RADIOACTIVITY IN DRINKING WATER. P. C. Gupta. Defence Sci. J. (New Delhi), 10: 337-43(1960).

The maximum permissible levels of radioisotopes in water, as laid down by the International Radiological Protection Committee, United Kingdom, and in U. S. A., are compared. To meet emergencies, the following permissible levels have been recommended to soldiers in the field for 10 days before a decontaminated water supply can be found (time after burst, μc/ml water): 12 hrs., 1.8×10^{-1}; 1 day, 6×10^{-2}; 2 days, 2×10^{-2}; and 10 days, 1×10^{-2}. At present, the methods of obtaining high-purity water for military personnel are ion exchange and distillation. A compact is yet to be designed for the soldier in the field. (Chem. Absts.)

9045 CONTRIBUTION TO THE FILM DOSIMETRY OF ENERGETIC QUANTA RADIATION. I. THEORETICAL FUNDAMENTALS. K. Becker. Fortschr. Gebiete Röntgen-

strahlen u. Nuklearmed., 95: 694-703(Nov. 1961). (In German)

In the theoretical part, the mechanism is discussed of the action of x rays and gamma radiation on photographic emulsions to which the organic fluorescent substance p-terphenyl was added. This addition was made to compensate for the energy dependence of the photographic dose response and to increase sensitivity. The consideration of the processes which produce photographic density permits qualitative and semiquantitative statements to be made, whereas a complete quantitative calculation is not possible because of the insufficient knowledge of some parameters. (auth)

9046 RADIOACTIVITY IN WATER AND TREATMENT OF CONTAMINATED WATER. E. Windle Taylor. Gas- u. Wasserfact, 102: 764-6(July 1961).

The various aspects of radioactivity in the water supply for the water works are discussed in general. Topics discussed include the damaging effect of radioactivity, radioactive influences on water, permissible activity level of water, disposition of radioactive water, radioactive fall-out, accidents, legal actions, measurements of radioactivity in water, and the decontamination of water. (Pub. Health Eng. Absts.)

9047 FISSION PRODUCT RELEASE FROM OVERHEATED URANIUM. A LABORATORY STUDY. R. K. Hilliard, C. E. Linderoth, and A. J. Scott (General Electric Co., Richland, Wash.). Health Phys., 7: Nos. 1 and 2, 1-10(Dec. 1961). (HW-SA-2040)

Preliminary tests investigated the oxidation and ignition behavior of unirradiated uranium in air and steam. Small uranium cylinders were then irradiated to 2×10^{14} nvt and heated out-of-reactor under carefully controlled conditions, and the fractions of the fission product isotopes leaving the specimen were determined. Temperatures up to 1440°C for as long as 4 hr in atmospheres of air, steam, and helium were measured; release in air was from two to ten times greater than in steam, while in helium the release was very low. Iodine, tellurium, and xenon were released in proportion to the amount of uranium oxidized. Cesium and ruthenium were found to be semi-volatile. The release of strontium, barium, and zirconium was found to be less than 0.2% under all conditions tested. Efficiencies of several filter media in retaining volatilized fission products were also measured. (auth)

9048 SOME TRENDS AND RECENT HEALTH PHYSICS INSTRUMENTATION DEVELOPMENTS AT HANFORD. R. A. Harvey (General Electric Co., Richland, Wash.). Health Phys., 7: Nos. 1 and 2, 11-16(Dec. 1961).

The radiological instrument development work of the Hanford Laboratories is reviewed with emphasis on particular classes of instruments to demonstrate the present thinking and the trends. In general, two groups of instrumentation are considered: The first is survey and monitoring instruments and the second is special purpose instruments. Photographs and descriptions are included. The survey and monitoring instruments include transistorized scintillation hand and shoe counters, an analyzing stack effluent radioisotope monitor, α-air monitors, transistorized scintillation portable survey instruments, and trends in environmental monitoring systems. The special purpose instruments are those which are used in biology and medicine programs other than instrumentation. These include an all automatic data gathering and radio telemetering system for meteorological and radiological purposes, an instrument for rapidly determining the number of zinc sulfide particles on a filter for meteorological experimentation, a solar radiation integrator for automatically averaging the output signal from a pyrheliometer, and instruments for delineating the radioactivity in various types of experimental animals. (auth)

9049 STATUS OF STATE LEGISLATION RELATED TO IONIZING RADIATION. Egilda D. Witherell and Russell F. Cowing (New England Deaconess Hospital, Boston). Health Phys., 7: Nos. 1 and 2, 17-19(Dec. 1961).

State legislation as it pertains to ionizing radiation was studied. More than half of the states in the country have Radiation Protection Acts; many states are in the process of promulgating rules and regulations under the Acts. The educational process will be helpful in promoting an effective code, and training of qualified personnel to effectively carry out the laws will be needed. (auth)

9050 TRICHLOROETHYLENE-SATURATED WATER AND TETRACHLOROETHYLENE CHEMICAL DOSIMETER SYSTEMS. NEUTRON RESPONSE. D. G. Ott, W. H. Schweitzer, J. A. Sayeg, and P. S. Harris (Los Alamos Scientific Lab., N. Mex.). Health Phys., 7: Nos. 1 and 2, 20-4 (Dec. 1961).

The response of the trichloroethylene-saturated water system was found to be dependent on neutron energy at 1 to 14 Mev. However, the response to fission neutrons with spectra of different degrees of degradation appears relatively constant. Measurements of neutron dose with this type of dosimeter can be made, subject to the limitations of the subtractive method, the experimental error, and calibration for neutron sensitivity. The low sensitivity to fast neutrons of the tetrachloroethylene dosimeter makes it valuable for the measurement of γ-dose in a mixed radiation field. Both types require suitable shielding from thermal neutrons. (auth)

9051 RESPONSES OF SILVER-ACTIVATED PHOSPHATE GLASS TO α-, β- AND γ-RAYS AND NEUTRONS. Sohei Kondo (Oak Ridge National Lab., Tenn. and National Inst. of Genetics, Misima, Japan). Health Phys., 7: Nos. 1 and 2, 25-35(Dec. 1961)

The responses of Ag-activated phosphate glass to α, β, γ, and neutron radiations were examined. In each case there is a linear relationship between the glass reading and dose of ionizing radiation. The reading per rad in the glass is independent of photon or β particle energy over a wide range, while at high LET it decreases with increasing LET, the reading being one-fifth as much per rad for α particles as for γ rays. The glass was applied successfully in absolute measurement of absorbed dose in a β-radioactive solution, separate measurements of γ-ray dose and thermal neutron flux in a thermal column, and measurements of x-ray dose distribution in a mouse. (auth)

9052 DOSIMETRIC PROPERTIES OF ELECTRETS. J. L. Wolfson and J. C. Dyment (National Research Council of Canada, Ottawa). Health Phys., 7: Nos. 1 and 2, 36-9 (Dec. 1961).

The dosimetric properties of resin-carnauba wax-beeswax electrets were studied using γ radiation from Co^{60}. The results are not completely accounted for by the explanation previously offered in terms of the formation of pseudo dipoles within the dielectric. Attention is drawn to the practical disadvantages of electrets in dosimetry. (auth)

9053 DOSIMETRY WITH SMALL SILVER-ACTIVATED GLASS RODS. Nathaniel F. Barr, Mary B. Stark, Joan Hands, and John S. Laughlin (Sloan-Kettering Inst., New York). Health Phys., 7: Nos. 1 and 2, 48-53(Dec. 1961).

The use of small silver-activated phosphate glass rods for ionizing radiation dosimetry is described. Convenient methods for the handling, reading, and calibration of the rods are reported. With the apparatus described fluorescence of the rods may be determined with a precision of 4%. With 20 Mev electrons and the γ rays from radium, iridium-192, and cobalt-60, the smallest detectable absorbed dose is approximately 30 rads. With 250 and 180 kvp x rays the smallest detectable dose is 3 rads. Variation in sensitivity of the rods with depth in an absorbing medium such as water is small with 22 Mev electrons, 250 kvp x rays and 180 kvp x rays incident on the surface. With the γ rays from cobalt-60, a 40% change in sensitivity was observed. The effects of exposure temperature, storage time, and ultraviolet exposure on the fluorescence of the rods are reported as well as the results of a limited number of applications. (auth)

9054 SOME CALCULATIONS ON THE ACCEPTABLE LIMITS FOR THE INHALATION OF RADIOSTRONTIUM IN AN EMERGENCY. G. W. Dolphin and I. S. Eve (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Health Phys., 7: Nos. 1 and 2, 61-8(Dec. 1961).

Acceptable limits for the inhalation of radiostrontium in an emergency are calculated. Several methods are used to calculate the acceptable limits based on the body burden concept, the maximum allowable dose to the whole skeleton, or the maximum allowable dose to a particular site in the bone. It was concluded that 0.5 μc is an acceptable amount for inhalation by adults of strontium-90 and 16 μc for strontium-89 in conformity with the accepted levels for the permissible dose in bone. A short discussion is given on applicability of these values to children in the environmental population. (auth)

9055 A LARGE WELL CRYSTAL FOR THE DIRECT MEASUREMENT OF TRACE AMOUNTS OF RADIOISOTOPES IN ENVIRONMENTAL SAMPLES. R. W. Perkins (General Electric Co., Richland, Wash.). Health Phys., 7: Nos. 1 and 2, 81-6(Dec. 1961). (HW-SA-1908)

A large diameter NaI(Tl) well crystal was evaluated for use in the measurement of trace amounts of radioisotopes in environmental, farm produce, and bioassay samples. A 500-g sample in its plastic container is counted directly in the crystal. With this detector, about an order of magnitude greater sensitivity is obtained for most radioisotopes than was observed with a conventional 3-in. diameter by 3-in. thick crystal. The detection limits for the measurement of 15 radioisotopes are from about 10^{-3} to 10^{-5} of the MPC's for these radioisotopes in drinking water. Typical spectra of vegetation, Columbia River water, and bioassay samples are presented. (auth)

9056 AN ANALYSIS OF THE CHICAGO SYNCHROCYCLOTRON PERSONNEL DOSES OVER A 6-YEAR PERIOD. V. Herrero Climent (Univ. of Chicago). Health Phys., 7: Nos. 1 and 2, 92-105(Dec. 1961).

Results of an analysis over a 6-year period (1954–1959) are presented. Included are: history and operational data of the Chicago Synchrocyclotron, comparative dose data by groups and years, and radiation incidents. In addition, doses greater than 0.3 rem/week are correlated with their causes and major operations are ordered according to their dose-producing potential. The aim is to provide a basis for dose estimates and work schedule construction, as well as to present a view of the synchrocyclotron from a health physics standpoint. In general, the average yearly dose per man tended to decrease, within the frame of current maximum permissible limits. Weekly overdoses were greatly reduced in 1958 and 1959. (auth)

9057 HEALTH PHYSICS FOR THE N. S. SAVANNAH. E. P. Resner (State Marine Lines, Inc., New York Shipbuilding Corp., Camden, N. J.), G. D. Schmidt, and R. J. van Turner. Health Phys., 7: Nos. 1 and 2, 114-17(Dec. 1961).

Discussion is given on the Savannah program, exposure control, shipboard facilities, monitoring system, protective measures, access control, waste management, servicing, pre-operational survey, and examination of the theoretical consequences of the maximum credible accident, with special emphasis on the applied health physics program in each. It is predicted that the shipboard design of health physics facilities and operational planning for the Savannah will provide the highest degree of nuclear and nautical safety for passengers, crew, and environment under all conceivable conditions. (P.C.H.)

9058 DEVELOPMENT OF SAFETY PERFORMANCE TESTS FOR RADIOISOTOPE SEALED SOURCES AND DEVICES. P. C. Aebersold and J. W. Hitch (U. S. Atomic Energy Commission, Washington, D. C.). Health Phys., 7: Nos. 1 and 2, 117-19(Dec. 1961).

Discussion is given on a program aimed at anticipating possible hazards from the many types of sealed sources, as well as isotopic devices, and to perform tests aimed at providing information for more accurate assessment of the risks involved in permitting wide beneficial usage. It is suggested that such information should lead to safer sources and devices and yet not cause unnecessarily strict standards for fabrication or use. The program consists of development and testing of radioisotope sources to assure: integrity of containment of radioactive material within the sealed capsule or imbedding matrix, and that, should the integrity of containment fail, the source material itself will constitute a minimal risk of dispersal and/or biological absorption; and development and testing of isotopic devices to assure: integrity of source within the device against accidental loss or willful pilfering, and maintenance of an adequate degree of shielding under probable conditions of use or accident. (P.C.H.)

9059 RADIOACTIVITY IN FOODS. II. EVIDENCE OF FALLOUT CONTAMINATION DURING 1958 AND 1959. Edwin P. Laug, Wendell C. Wallace, Mae S. Walton, Mary J. Verrett, James M. Dimitroff, and Sidney Davis. J. Assoc. Offic. Agr. Chemists, 44: 523-30(Aug. 1961).

During 1958 and 1959, approximately 5,000 samples of 50 different human and animal foods were examined for total radioactivity resulting from fall-out. Highest total concentration was found in the animal fodders and tea. Among the animal fodders, the alfalfas were about 4 times as radioactive as the corn ensilages. In the case of tea, the imports from Japan, Formosa, and India carried the greatest amount of radioactivity. Significantly lower concentrations were noted in African and Brazilian teas. Lower, in comparison by factors ranging from $\frac{1}{10}$ to $\frac{1}{100}$ of the above but still measurable, was the radioactivity in fresh vegetables. Most of the contamination was found in spinach, celery, lettuce, and greens in that decreasing order. As compared to the fresh vegetables, fruits were on the average only $\frac{1}{4}$ as radioactive. Measurable quantities of radioactivity were found only in plums, prunes, and strawberries, in that decreasing order. As noted in an earlier surveillance study, significant radioactivity continued to be detected in dairy products; also in oysters and clams. Insignificant traces of radioactivity were found in salmon and tuna, and none whatsoever in meat and poultry. Nearly all total β concentrations declined from 1958 through 1959, reflecting the cessation

of weapons testing late in 1958. Analyses showed that on the average about 10% of the total β level in a food could be accounted for by the presence of strontium-90. 10 tables. Figure. 5 references. (auth)

9060 PROBLEMS OF MILK SUPPLY ASSOCIATED WITH POSSIBLE NUCLEAR REACTOR ACCIDENTS. Gerald M. Ward (Los Alamos Scientific Lab., N. Mex.). J. Dairy Sci., 44: 1958-61(Oct. 1961).

Problems related to handling a significantly contaminated milk supply are discussed. The questions raised are secondary to monitoring and protection of public health by restricting the milk supply. The problems discussed are primarily problems not of public health but of public relations. An attempt is made to show that broad policies can and should be made in advance, which would eliminate the need for hurried and possibly ill-considered decisions in the heat of an emergency. Reference is made to the Windscale incident in England. (P.C.H.)

9061 REMOVAL OF RADIOACTIVE CONTAMINANTS FROM WATER. Don C. Lindsten, Richard P. Schmitt, and William J. Lacy. Military Engr., 53: 368-9(Sept.-Oct. 1961).

A study was made to evaluate field water treatment procedures for removing radioactive contaminants from a natural water source. Although the water treatment equipment was designed for support of military operations, the basic processes of coagulation, filtration, and ion exchange make it suitable for use in civilian installations. 3 figures. (auth)

9062 FOOD AND WATER SUPPLY IN NUCLEAR WAR. Thomas R. Ostrom. Military Med., 126: 767-71 (Oct. 1961).

With existing supplies, it is possible to provide food and water for military and civilian populations after a nuclear attack. There are extant methods for decontaminating water, livestock, and packaged foodstuffs. (auth)

9063 BODY-CROSS-SECTION SCAN PHANTOM FOR THE STUDY OF SCINTILLATION COUNTING PROBLEMS IN NUCLEAR MEDICINE. Arthur F. Dratz, James C. Coberly, and Robert H. Rohrer (Veterans Administration Hospital, Atlanta and Emory Univ., Atlanta). Rev. Sci. Instr., 33: 12-13(Jan. 1962).

A body cross-section scan phantom was designed to study problems involved in the external detection of radioactivity in human organs. It is based upon the use of serial cross-sectional drawings of a particular body area reproduced in metallic paint. A commercial scanning mechanism moves a small electrode over one of the cross sections, and simultaneously moves a small radioactive source through a tank of water. The entire system is aligned in three dimensions relative to the position of a scintillation detector. Each organ area drawn on the cross-section is part of an individual scaling circuit which is activated by the moving electrode. Thus, by scanning the drawing, a summation of the counts due to activity in each of these cross-sectional areas can be automatically registered. The three dimensional response is determined by graphically integrating the data from all the cross sections. (auth)

9064 ON RADIATION IN MILK. C. W. Hubbard. Sanitarian, 24: No. 2, 76-88(Sept.-Oct. 1961).

A basic explanation of radioactivity in foods covering atomic structure, radioactivity, radium standard, mathematics, and technique. (Public Health Eng. Abstr., Vol. 42, No. 1-2)

9065 RADIOAKTIVNYE VYBROSY V ATMOSFREY. (PROCKTIROVANIE USTANOVOK DLYA OCHISTKI VYBROSOV OT AEROZOLEI I GAZOV). (Radioactive Waste in Atmosphere. (Devices for Purifying Aerosols and Gases). S. A. Prechistenskii. Moscow, Gosatomizdat, 1961. 175p.

Installations and methods for radioactive aerosol filtration and purification are discussed. The technology of aerosol filtration by fiber polymers, sparging absorption, centrifugal separation gas absorption, and special combined methods is analyzed, and data and instructions are supplied for designing equipment. Permissible doses of poisonous gases, vapors, and dust in working areas and the maximum permissible concentrations of radioactive substances in the air are also included. (R.V.J.)

9066 STRAHLENGEFAHR UND STRAHLENSCHUTZ. (Radiation Danger and Protection). Oskar Hoefling. Mathematisch-Naturwissenschaftliche Taschenbücher. Band 1/2. Bonn, Ferd. Dümmlers Verlag, 1961. 248p. DM 5.80.

The problems of radiation danger and protection are discussed. Topics covered include radiation as an energy form, the different kinds of radiation, the structure of the atomic nucleus, natural radioactivity, artificial radioactivity, radiation and materials, principles of radiation dosimetry, activity and the curie unit, energy dose and the rad unit, ionizing dose and the roentgen unit, relative biological effect and the rem unit, apparatus for the detection and measurement of energetic radiation, the biological effects of radiation, the cells as structures of the organism, mutation, somatic and genetic radiation injuries, the radiation load on man, energetic radiation in medicine and industry, radiation dangers from atomic bomb testing, population genetics and radiation injuries, and legal radiation protection. (M.C.G.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

Refer also to abstract 9202

9067 (ARF-1194-7) LITERATURE SURVEY ON WORLD ISOTOPE AND RADIATION TECHNOLOGY. First Semi-Annual Report Covering Period from June 15, 1961 to December 14, 1961. J. W. Haffner and D. Oestreich (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 10, 1962. Contract AT(11-1)-578. 50p.

Work is in progress on a literature survey designed to investigate the uses and technology of radioisotopes in the countries of the world from 1955 to the present. Particular emphasis was necessarily placed on the work of the more highly industrialized nations. This survey was planned to include two phases. Phase I, which is essentially completed, involved the direct comparison of radioisotope work in all fields in various countries as demonstrated at international conferences. Each paper presented at such a conference was classified according to date, country of origin, and field of research. Phase II, which is continuing at the present time, involves a more detailed examination and evaluation of the individual fields of interest selected previously. The following fields were examined: chemistry, geology and mining, and one portion of metallurgy. Work on industrial applications and instrumentation for use with radioisotopes is underway. (auth)

9068 (MND-2584-3) RADIOISOTOPE SEMICONDUCTOR AND THERMOELEMENT RESEARCH AND DEVELOPMENT. Quarterly Progress Report No. 3, September 1 to November 30, 1961. J. B. Weddell (Martin Co. Nuclear Div., Baltimore). Dec. 21, 1961. Contract AT(30-1)-2698. 58p.

The thermodynamic heat and charge transport equations were simplified to conform to the cases to be covered by experiment, and most of the constants appearing in the equations were evaluated. Specimens of titanate materials were prepared by sintering in hydrogen at 1475°C. Materials prepared include strontium-90 titanate doped with iron, cerium titanate doped with iron and tungsten, and blends of cerium dioxide, titanium dioxide, and iron-doped strontium titanate. Cerium titanate ($CeTiO_3$) was identified by x-ray diffraction analysis; this compound was not previously reported. The Seebeck coefficient, electrical resistivity, thermal conductivity, Hall coefficient, activation energy and x-ray diffraction pattern of various strontium and cerium titanate materials were measured. The thermoelectric properties were measured in the temperature range from 20° to 1140°C. Blends of cerium titanate and iron-doped strontium titanate have merit factors (Seebeck coefficient squared, divided by electrical resistivity) of 7×10^{-6} watt $cm^{-1}°C^{-2}$ or more from 100° to 1000°C. The thermoelectric optimization code for the IBM 7090 computer was modified to permit variation of thermoelectric properties with position along the elements, to make the solution converge for small values of the output power and to reduce the computation time. A device to demonstrate the production of electrical energy in a pellet of strontium titanate containing strontium-90 near one end was designed. (auth)

9069 (NYO-2631) EXPLORING RADIOISOTOPE APPLICATIONS IN THE PHARMACEUTICAL AND ALLIED INDUSTRIES. Final Report. Robert L. Bogner, Alfred P. Intoccia, Monroe S. Glitzer, John M. Walsh, Stamos Eleftheriou, David Isaacson, and Abraham Edelmann (Nuclear Science and Engineering Corp., Pittsburgh). Nov. 1961. Contract AT(30-1)-2359. 228p.

Experiments were carried out to test the usefulness of selected isotopes as indicators of estrogenic or androgenic activity. The nuclides Na^{22}, Zn^{65}, I^{131}, and P^{32} were employed in tissue uptake studies in response to graded estrogenic stimulation in both adult-ovariectomized and immature rats. Of the four isotopes tested, Na^{22} demonstrated the most useful log-dose response relationship when uterine Na^{22} of immature rats was measured. The assay can be performed in six hours and its ability to detect an unknown amount of estrogenic material was demonstrated. The method was found to be specific in the presence of progesterone, but cortisone altered the Na^{22} uptake of the uterus. The range of estradiol detection was between 0.025 and 0.2 micrograms. The comparative ability of Zn^{65}, Na^{22}, and P^{32} to detect androgenic substances by measuring tissue levels of these nuclides in response to graded dosages of testosterone propionate was investigated. Zn^{65} uptake in the seminal vesicles of immature intact rats was found to produce the best response when related to the log-dose of injected androgen. The method could be performed in twenty-four hours and was demonstrated to be specific in the presence of cortisone, but not in the presence of progesterone. The range of detection of testosterone was 0.625 to 100 micrograms. A sodium-22 bioassay method for estrogen detection and a zinc-65 bioassay for androgen detection, thus have the potential of greatly reducing the time, labor, and cost of conventional bioassay procedures for these substances. Suggested assay procedures are provided. Isotope dilution analyses have been utilized in the discipline of biochemistry when it has been mandatory to detect and quantitative minute quantities of substances in complex media. Applications of such analytical tools to similar problem areas in industry have been uncommon. Investigations of selected aspects of the most valuable type of isotope dilution techniques, viz., isotope derivative analysis, as applied to measurements of amphetamine were made. Certain of the problem areas inherent in the development of such an analytical scheme were outlined and recommendations for additional studies were discussed. Although the development phase of dilution analyses may be extensive, previous experiences have indicated that actual application of a developed scheme to routine analyses involves no more time and effort than conventional analytical methodology, whereas, the sensitivity and specificity of detection by isotope derivative analysis are increased. (auth)

9070 SOME BREMSSTRAHLUNG SOURCES IN THICKNESS GAGES. Tadeusz Florkowski (Academy of Mining and Metallurgy, Krakow). Nukleonika, 6: 779-85(1961). (In Polish)

The possibility of the use of bremsstrahlung sources with β emitters $Sr^{90} + Y^{90}$ and Kr^{85} in the thickness gages is described. Energy spectra and absorption curves in lead, iron, and aluminum are given and the possibility of the choice of NaI(Tl) thickness for required thickness range is discussed. (auth)

9071 THE TECHNOLOGICAL USE OF RADIATION, 1960. PROCEEDINGS OF A CONFERENCE ON THE TECHNOLOGICAL USE OF RADIATION, HELD IN SYDNEY, FROM MAY 23 TO 25, 1960. (Australia. Atomic Energy Commission). 145p. 30s. (Melbourne University Press).

Proceedings of a conference on the Technological Use of Radiation are presented. Separate abstracts were prepared for 19 papers presented at this conference. Two papers were previously abstracted for NSA, and for two other papers only abstracts are presented. (C.H.)

9072 GAMMA RADIATION PROCESSING. G. S. Murray (Gamma Sterilization Pty., Ltd., Dandenong, Victoria, Australia). p.1-5 of "The Technological Use of Radiation, 1960." Australia, Atomic Energy Commission.

The present status of gamma radiation processing is briefly reviewed. Various sources of gamma radiation are compared, availability, cost and other considerations indicating a clear preference for cobalt-60 at the present time. The relationship of source size to throughput is dependent upon efficiency. Factors effecting efficiency are discussed. The essential functions of the type of plant required for gamma radiation processing are described and illustrated by reference to plant in operation or construction. Estimated basic costs for plant and radiation source are used to illustrate the need for high efficiency and throughput. Probable immediate applications and possibilities for the future are suggested. (auth)

9073 SOME FACTORS IN IRRADIATION PLANT DESIGN. SOURCE AND TARGET PARAMETERS. J. G. Clouston (A.A.E.C.R.E., Lucas Heights, Australia) and F. Rogers. p.6-11 of "The Technological Use of Radiation, 1960." Australia, Atomic Energy Commission.

Physical factors are considered in relation to efficiency of source utilization. The necessity of correlating these factors with engineering considerations is emphasized. (auth)

9074 THE DESIGN AND CONSTRUCTION OF THE Co-60 CAVE IN THE UNIVERSITY OF N.S.W. C. L. Samways (Univ. of New South Wales, Sydney). p. 12-20 of "The Technological Use of Radiation, 1960." Australia, Atomic Energy Commission.

The design and construction of a cave-type irradiation facility is described. The radioactive material used is Co^{60} in the form of 16, $\frac{1}{2}$-in. diameter pellets, set in a circle 4-in in diameter. The irradiation space 8-ft. × 11-ft. is enclosed by 4-ft. thick brick and concrete walls, and the source, when not in use, is held 11-ft. down a water filled well. A simple, yet novel, remote viewing system and mechanical safety interlock to prevent accidental exposure are described. (auth)

9075 DESIGN AND CONSTRUCTION OF A SIMPLE 200 CURIE CAESIUM 137 RADIATION FACILITY. J. M. Bayley (J. Bayley and Sons Ltd., Botany, New South Wales, Australia) and J. H. Green. p.26-7 of "The Technological Use of Radiation, 1960." Australia, Atomic Energy Commission.

A simple structure of filled concrete blocks was made to enable the use of two 100-curie cesium gamma sources for technical and research studies in radiation chemistry and biology. Details of construction from local materials and source–material geometry are given briefly. (auth)

9076 ELECTRON ACCELERATORS. D. Gantt (High Voltage [Engineering] Corp. [Burlington, Mass.]). p.28-9 of "The Technological Use of Radiation, 1960." Australia, Atomic Energy Commission.

Recent design developments for electron accelerators are reviewed. Reliable operation of industrial machines over a 15-month period is reported. Typical industrial applications include the irradiation of wire and cable to increase its heat resistance, polyethylene film for the same reason, almost all kinds of bugs and insects for research programs, seeds and plants for growth and mutation studies, diamonds to change their color and increase their value, the sterilization of sutures, catheters, bondages, disposable syringes, containers for ointments and salves, meat products for heredity studies in animals, and transistors to change their structure and improve their operation. (C.H.)

9077 U.S.A.E.C. INDUSTRIAL PROCESS RADIATION RESEARCH PROGRAMME. David M. Richman and Paul C. Aebersold (U. S. Atomic Energy Commission, Washington, D. C.). p.30-43 of "The Technological Use of Radiation, 1960." Australia, Atomic Energy Commission.

It is the objective of the United States Atomic Energy Commission's Industrial Process Radiation Program to bridge the wide gap that exists between basic radiation chemistry research performed mainly by universities and national laboratories and highly applied research on products of commercial value performed mainly by private industry. The program attempts to make use of basic research results to support and indicate fruitful directions for applied research efforts. It also provides for complementary studies, both basic and applied, on chemical systems of commercial interest. Some specific technical problems that have been defined over the last decade as a result of both basic and applied research efforts are described. These include knowledge and understanding of ion-molecule reaction mechanisms, energy transfer mechanisms, and the effect of the structure of molecules on radiation chemistry reaction mechanisms. These problems can be solved through fundamental research on mechanisms of chemical reactions in irradiated systems. The need to understand these mechanisms and to discover techniques for selectively controlling them is stressed. Research projects attacking these problems described in detail include experimental studies on the life times of singly and doubly charged ions in gaseous systems, relative effectiveness of ion-molecule and free radical mechanisms for inducing specific chemical reactions in liquid systems, techniques for controlling reaction mechanisms in liquid systems through electron trappings, effect of molecular structure on graft copolymer products, and techniques for reducing dose required for curing polymers. A number of chemicals that appear to have promise for production using ionizing radiation are discussed. These include phenol, aniline, fluorinated aromatic hydrocarbons, ethylene glycol, hydrazine, and acetylene. (auth)

9078 TECHNOLOGICAL APPLICATION OF RADIATION IN NEW ZEALAND. G. S. McNaughton (Nuclear Science Inst., D.S.I.R., Lower Hutt, N. Z.). p.44-6 of "The Technological Use of Radiation, 1960." Australia, Atomic Energy Commission.

Work done in different Divisions of the New Zealand Department of Scientific and Industrial Research is described. This is limited by radiation sources available, the most recent being a 240–curie cobalt–60 gamma irradiation unit. Most work has been done in the production of mutants by radiation. A lupin with pods less liable to shatter before harvest is being developed, and the effect of moisture content on the radiation sensitivity of lupin is described. Other work is in progress with paspalum and turnip. Preliminary results on the inhibition of sprouting of potatoes and a new project to inhibit core flush in apples are also discussed although the investigations are still at an early stage. (auth)

9079 CHEMICAL RADIATION DOSIMETRY. J. H. Green (Univ. of New South Wales, Kensington, Australia). p.47-52 of "The Technological Use of Radiation, 1960." Australia, Atomic Energy Commission.

A brief account is given of the present status of the radiation dosimetry of strong sources and high energy machines. The advantage of simple chemical dosimeters in technological studies is stressed. (auth)

9080 RADIATION STERILIZATION IN THE UNITED KINGDOM. Dennis B. Powell (Atomic Energy Research Establishment, Wantage, Berks, Eng.). p.57-64 of "The Technological Use of Radiation, 1960." Australia, Atomic Energy Commission.

The development of gamma radiation facilities using cobalt-60 has opened up the possibility of radiation sterilization on a commercial scale. The method has several important advantages, particularly in the processing of heat-labile materials such as rubbers and plastics. The choice of packaging materials is also broadened by the low temperature rise in the process. (auth)

9081 RESEARCH TRENDS IN THE TREATMENT OF FOOD AND THERMOLABILE DRUGS BY IONIZING RADIATION. R. F. Mouton (International Atomic Energy Agency, Vienna). p.65-70 of "The Technological Use of Radiation, 1960." Australia, Atomic Energy Commission.

Radiation sterilization combined with anti-autolytic preservation processing of food, prevention of germination of food, and wholesomeness tests of irradiated food are discussed, together with the subject of radiation sterilization of pharmaceutical products. References are made to the present program of relevant I.A.E.A. research projects in selected topics of fundamental radiobiology. (auth)

9082 RADIATION AND PLANT IMPROVEMENT IN AUSTRALIA. R. D. Brock (C.S.I.R.O., Canberra, Australia). p.71-5 of "The Technological Use of Radiation, 1960." Australia, Atomic Energy Commission.

The theoretical basis of mutation plant breeding is reviewed and current research in Australia is discussed. (auth)

9083 CHEMICAL EFFECTS FROM THE IRRADIATION OF WOOD. J. L. Garnett (Univ. of New South Wales, Sydney) and J. W. T. Merewether. p.76-81 of "The Technological Use of Radiation, 1960." Australia, Atomic Energy Commission.

The effect of ionising radiation on the chemical structure of wood was briefly investigated by subjecting Eucalyptus regnans wood meal to varying doses of gamma radiation from a cobalt-60 source. Up to a dosage of 10^7 rads radiation has only a slight effect, the ethanol solubility of the wood increasing from 0.4 to 1.5%, and the 0.5% aqueous NaOH solubility increasing from 9.8 to 18.4%. Above 10^7 rads the effect was considerable, and at $10^{8.5}$ rads the ethanol solubility of the wood was 30.0%, from which 8.2% lignin with 23.1% OCH_3 was recovered, and the alkali solubility was 57.4%, from which 8.8% of a crude lignin was obtained. (auth)

9084 RADIATION INDUCED REACTIONS IN GASES. D. R. Stranks (Univ. of Melbourne). p.85-90 of "The Technological Use of Radiation, 1960." Australia, Atomic Energy Commission.

A critical evaluation is presented of several alternative experimental techniques for the development in gases of dose rates exceeding 10^5 r/min. These techniques utilize either radioactive sources, a nuclear reactor, or electrical discharges. Isotopic exchange between carbon dioxide and carbon monoxide may be induced in boron-coated silica vessels in a neutron flux. The results provide further information on the mechanism of radiolysis of carbon dioxide and on the steady-state attained after prolonged irradiation. (auth)

9085 AUSTRALIAN ARMY INTERESTED IN FOOD IRRADIATION. W. M. Aird (Army Food Science Establishment, Melbourne). p.91-5 of "The Technological Use of Radiation, 1960." Australia, Atomic Energy Commission.

The problems associated with Army food supply and the current methods by which food for Service use is preserved are discussed. The advantages which irradiation offers as a means of reducing refrigeration commitments and of extending the shelf-life of processed commodities, are also covered. A brief resume is given of the results of research into food irradiation in America and the United Kingdom. (auth)

9086 THE APPLICATION OF SUB-STERILISING DOSES OF RADIATION TO FRESH FOODS. J. J. Macfarlane (C.S.I.R.O., Homebush, New South Wales, Australia). p.96-103 of "The Technological Use of Radiation, 1960." Australia, Atomic Energy Commission.

Sub-sterilising or pasteurisation doses of radiation, particularly when used in conjunction with refrigeration, have considerable potential as a means of extending the storage life of many fresh foods, while at the same time causing only slight radiation damage. Foods vary greatly in their response to radiation, and some products show more promise than others. There may even be considerable variation within a particular type of food. It is desirable, therefore, to carry out experiments with material produced under local conditions. Even small doses of radiation cause some damage to the desirable characteristics of a foodstuff. While there is much interest in ways of reducing this damage to product quality, little success has so far been achieved. In addition, some radiation-pasteurised products have been found to lose acceptability during chilled storage before being spoiled microbiologically, so reducing the apparent gain of the radiation treatment. Micro-organisms vary greatly in their radiation sensitivity, and irradiated products tend to be spoiled by the more resistant members of the original microflora. The widespread use of irradiation may ultimately increase the incidence of radiation-resistant organisms. Some of the effects of applying pasteurisation doses of radiation to beef, fruit, vegetables, and frozen whole egg pulp are considered. (auth)

9087 INSECT CONTROL BY IONIZING RADIATIONS. An Appraisal of the Potentialities and Problems Involved. P. B. Cornwell (Atomic Energy Research Establishment, Wantage, Berks, Eng.). p.104-16 of "The Technological Use of Radiation, 1960." Australia, Atomic Energy Commission.

As a result of the development of the nuclear power program, penetrating radiation from gamma emitting isotopes is now available and will become more widely so in the near future. Experimental sources of cobalt-60, made radioactive by neutron irradiation, have been used during recent years for investigating the radiation susceptibility of insect pests. Considerable advances have been made in the design and development of electron machines with the acceleration of more intense beams of electrons than have been achieved previously. Lethal and sterilizing effects of ionizing radiations have been examined on species, strains, and developmental stages to evaluate the dose levels required for commercial treatment. The technical feasibility of using radiation as an insecticide is now established. Results of research and problems of application are examined in relation to the practical feasibility

of applying radiation disinfestation to stored products commodities. The most favorable products for radiation disinfestation are those handled in bulk at particular centers, and for this reason radiation treatment of grain has been examined in detail. The fundamental and applied problems of using ionizing radiations for this purpose are discussed and the relative merits of fumigation and radiation sterilization are compared. It is concluded that among factors which may influence the success of radiation disinfestation, bulk handling and the incorporation of treatment into established handling procedures must receive primary consideration. Ionizing radiations may eventually take their place as a useful means of insect control but their adoption is unlikely to displace conventional methods. (auth)

9088 INSECT ERADICATION BY STERILE MALE RELEASE. An Appraisal of the Method for Control of Australian Sheep Blowfly. J. O. Bull (Atomic Energy Research Establishment, Wantage, Berks, Eng.). p.117-29 of "The Technological Use of Radiation, 1960." Australia, Atomic Energy Commission.

Eradication of insects by release of sterile males exploits the mating behavior of the male to find and inseminate the female with sterile sperms. Operation of the method and factors essential for success are reviewed in relation to the eradication of screw-worm fly (Callitroga hominivorax) and its possible application to Australian sheep blowfly (Lucilia cuprina). The biology and ecology of the two species are compared. The effects of radiation are considered in relation to emergence, deformity, longevity, mating behavior, and sterility. (auth)

9089 THE POSSIBLE USE OF STERILE MALES IN CONTROLLING OR ERADICATING QUEENSLAND FRUIT-FLY. J. Monro (Univ. of Sydney). p.130-7 of "The Technological Use of Radiation, 1960." Australia, Atomic Energy Commission.

The Queensland fruit-fly, Dacus tryoni is a destructive pest in Queensland and New South Wales and an expensive potential pest in Victoria and South Australia. Selection at the southern limits of its distribution may yet give rise to a new permanently established race. In theory such populations of sexually reproducing organisms could be eradicated by repeatedly releasing males sterilized by gamma-rays. The conditions for eradication are discussed and illustrated by reference to current work on D. tryoni. (auth)

9090 IMPROVEMENTS IN OR RELATING TO LUMINOUS BODIES. Eberhard Lenze. British Patent 887,566. Jan. 17, 1962.

A self-luminous body is designed which comprises a radioactive gamma source located within a hollow body which is filled with a metal vapor gamma frequency converting medium and surrounded by a carrier for the luminescent material. The hard rays of the source are converted by the metal vapor to soft rays which produce light in the luminescent material. The light intensity may be varied by means of layers stopping part of the alphas, betas, and gammas from the source. (D.L.C.)

ISOTOPE SEPARATION

9091 (AERE-M-968) THE ROLE OF ELECTROMAGNETIC ISOTOPE SEPARATION IN PRODUCING ^{47}Ca. J. H. Freeman (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Jan. 1962. 10p.

It is suggested that the production cost of Ca^{47} could be reduced significantly by carrying out a post-irradiation electromagnetic isotope separation of the Ca^{47} from the unused separator-enriched Ca^{46}. The separation would give Ca^{47} essentially free from the long-lived undesirable Ca^{45}, and the costly Ca^{46} would be recovered for recycling. The present system wastes almost all of the Ca^{46} used. (auth)

9092 (AEC-tr-4987) ISOTOPE SEPARATION BY MEANS OF AN ELECTRIC MASS FILTER. F. v[on] Busch and W. Paul. Translated for Oak Ridge Gaseous Diffusion Plant, Tenn. from Z. Physik, 164: 581-7(1961). 12p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 6680.

9093 (AEC-tr-4990) DEVICE FOR THE SEPARATION OF GASEOUS COMPONENTS OF DIFFERENT MOLECULAR WEIGHT. Hans Martin. Translated for Oak Ridge Gaseous Diffusion Plant, Tenn. from German Patent 1,060,360. July 2, 1959. 8p.

A device for the separation of gaseous components of different molecular weights is described. A rotating elongated cylinder was provided with heated end plates but no inserts with a multiplication of the primary separation stage by an axially directed countercurrent guidance of the gas mixture. Guiding passages were provided at or in both end plates and shafts of the cylinder. Gas transport devices were arranged on the outside of the cylinder in such a manner that gas is aspirated continuously in the center of one end plate from the rotating cylinder and reenters the cylinder at the edge of this end plate, while gas is continuously aspirated at the edge of the cylinder at the other end plate and returned to the cylinder in the center of this end plate together with fresh gas. (M.C.G.)

9094 (AEC-tr-4992) METHOD FOR THE PRODUCTION OF A POROUS BARRIER FOR ISOTOPE SEPARATION BY MEANS OF DIFFUSION THROUGH THIS BARRIER AND BARRIER MANUFACTURED WITH THE AID OF THIS METHOD. Paul Christiaan van der Willigen and Sjerp Anne Troelstra. Translated for Oak Ridge Gaseous Diffusion Plant, Tenn. from Dutch Patent 98,129. June 15, 1961. 9p.

A method is described for the manufacture of a porous barrier suitable for the separation of hexafluorides for the uranium isotopes U^{238} and U^{235}. A barrier of the required form is produced from a plastic mass of powdered calcium fluoride and a binder which is a gel of calcium fluoride prepared with the aid of an aqueous solution of a gelling agent which when heated to 100 to 1200°C decomposes leaving a material which is not attacked by hexafluorides. (M.C.G.)

9095 (AEC-tr-4993) METHOD OF SEPARATION OF URANIUM ISOTOPES. Yokushiro Shiraishi. Translated for Oak Ridge Gaseous Diffusion Plant, Tenn. from Japanese Patent 8,479/1960. July 4, 1960. 6p.

A method is presented for separating uranium isotopes. The metallic uranium is dissolved in metals such as Hg, Sn, W, Zn, Cr, Fe, Mo, Ni, Al, Pb, etc., then the solution is heated to a high temperature to vaporize the uranium with the metal. The vapors are then condensed to concentrate U^{235}. (M.C.G.)

9096 ELECTROMAGNETIC SEPARATION OF RADIOACTIVE ISOTOPES. PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM HELD IN VIENNA, MAY 23-25, 1960. M. J. Higatsberger and F. P. Viehboeck, eds. Vienna, Springer-Verlag, 1961. 326p. $13.50.

Thirty-four papers are presented; separate abstracts are prepared for 29 papers, 4 were previously abstracted, and one was not abstracted in NSA. The 4 papers previously abstracted are The Relative Enhancement Factor in Electromagnetic Isotope Separation, Electromagnetic Separation of Radioisotopes of the Heavy Elements at Oak Ridge National Lab, Ion Sources with High Efficiency and Intensity, and Protective Measures in Connection with Electromagnetic Separations of Radioactive Isotopes at Oak Ridge National Lab. The paper not abstracted is Sputtering at High Energy. (P.C.H.)

9097 ELECTROMAGNETIC ISOTOPE SEPARATION BEFORE AND AFTER ACTIVATION IN A REACTOR OR CYCLOTRON. Karl Ove Nielsen (Danish Atomic Energy Commission, Risö). p.1-9 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

General features of various separation combinations are discussed. In the production of separated sources a combination of instruments which proved advantageous in a few cases is the utilization of both calutron and laboratory isotope separation together with activation in either a reactor or a cyclotron. It was concluded that the most logical production sequence is as follows: separation in a calutron, giving relatively large quantities of material; activation in either a reactor or a cyclotron; and separation in a separator of medium size, giving a high degree of purity and, simultaneously, ideal preparation of the source. (P.C.H.)

9098 ELECTROMAGNETIC MASS SEPARATION OF REACTOR IRRADIATED MATERIALS. P. Weinzierl and M. Tisljar (Österreichische Studiengesellschaft für Atomenergie G.m.b.H., Vienna). p.10-16 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Discussion is given on the separation of samples of moderate activity (<1 c) after irradiation in a reactor. An activity of 10^6 decays/sec was chosen as a typical value for nuclear spectroscopy investigations. Histograms of irradiated natural isotope mixtures and pure isotopes are given and discussed. It is felt that the discussion illustrates the usefulness of a mass separator for reactor-activated samples. (P.C.H.)

9099 THEORY OF ISOTOPIC CONTAMINATION IN ELECTROMAGNETIC SEPARATORS. Ch. Cassignol (Centre d'Etudes Nucléaires, Saclay, France). p.17-34 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Contamination diagrams are defined, and the empirical laws of isotopic contamination are reviewed. Discussion is given on scattering as a mechanism of isotopic and hash contamination. Next, discussion is given on whether or not all the known phenomena of isotopic contamination can be explained by condensing all the scattering and hash mechanisms into a single comprehensive framework. Applications are given. (P.C.H.)

9100 ADEQUATE CHARACTERIZATION OF SEPARATING POWER. Karl Ove Nielsen (Danish Atomic Energy Commission, Risö). p.35-9 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Various possibilities of characterizing the separating power of an isotope separator are discussed. Definitions are given for enhancement (E) and relative enhancement (E_R), and it was concluded that E_R is more suitable than E for characterizing the separating power of an instrument. (P.C.H.)

9101 CONTRIBUTION TO THE STUDY OF ISOTOPIC CONTAMINATION WITH A DOUBLE MAGNETIC DEFLECTION ISOTOPE SEPARATOR. R. Bernas, J. Camplan, M. van Ments, and J. L. Sarrouy (Université, Paris, Laboratoire de Physique Nucléaire, Orsay, France). p.68-80 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

The second magnetic stage of an electromagnetic isotope separator was used for the analysis of the isotopic composition of the ion beam which enters the collector. This gives an accurate indication of the nature of contamination in these instruments. Although the contribution of fast neutral particles produced by change of charge is important, it can easily be eliminated and does not constitute a limiting factor to isotopic purity. This limit is due to scattered ions and, for a small part, to ions that were slowed down or that did not receive the full accelerating voltage. The contribution of neutrals is obtained from the difference between the isotopic composition of a deposit made on the first stage collector and that of the corresponding ion beam analyzed by the second stage. The experiments were carried out on Sr, Yb, and U. The results confirm the preferential contamination by neighboring isotopes of heavier mass. The origin of this asymmetry is discussed. The consequences of these various processes on the limiting performances of magnetic cascades were studied. (auth)

9102 ELECTROMAGNETIC SEPARATOR FOR RADIOISOTOPE INVESTIGATIONS. N. J. Freeman, W. A. P. Young, R. W. D. Hardy, and H. W. Wilson (United Kingdom Atomic Energy Authority, Aldermaston, Berks, Eng.). p.83-90 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Details are given of the vacuum system, magnet, ion source, electrostatic focusing system, and electrical supplies of a 100-cm radius, 90°-sector, electromagnetic separator under construction at A.W.R.E., Aldermaston. The machine is designed to produce milligram quantities of stable isotopes and radioactive isotopes up to 1-mc strength. An effort is being made to secure a higher vacuum than was used in the past, with the principal objects of obtaining a higher resolution and enrichment factor. (auth)

9103 THE DESIGN OF THE ELECTROMAGNETIC ISOTOPE SEPARATOR OF THE S.G.A.E. F. P. Viehboeck (Österreichische Studiengesellschaft für Atomenergie G.m.b.H., Vienna). p.91-102 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Details are given of the magnetic field, ion source, vacuum system, and power supply of the electromagnetic isotope separator of the S.G.A.E. The separator will be a medium-size machine with a total ion current at the target of about 5 mamp for medium masses. The total radioactivity to be handled at one time will be of the magnitude of several hundred millicuries. The separation plant arrangement is also discussed. (P.C.H.)

9104 PLANS FOR A RADIOISOTOPE SEPARATOR AT CERN. G. Andersson (Gustaf Werner Inst. for Nuclear Chemistry, Uppsala), B. Hedin, and G. Rudstam. p.103-10 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Details are given of a radioisotope separator developed for sample preparation in connection with spallation and high-energy fission studies using the 600 Mev synchrocyclotron and the 25 Bev proton synchrotron. The rather special application led to the following performance requirements: low intensity ($I_{tot} < 500$ μamp) but high efficiency and reasonable dispersion up to the highest atomic masses; simultaneous collection at equivalent focusing conditions of masses within ±10% from that of the central beam; and approximately circular samples in direct deposition, because end-window counters are used in the yield measurements and scintillation spectroscopy will be used for the characterization of the nuclear species. (P.C.H.)

9105 ION-OPTICAL CONSIDERATIONS ON E.M. SEPARATORS. W. Walcher (Universität, Marburg, Ger.). p.111-12 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

The treatment of electromagnetic separators as optical systems is shown to lead to optimum design. (P.C.H.)

9106 THE ELECTRIC QUADRUPOLE MASS SEPARATOR. F. v[on] Busch, W. Paul, H. P. Reinhard, and U. v[on] Zahn (Universität, Bonn). p.113-20 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Experimental details, which appeared during the investigation of the electric quadrupole mass separator, are presented. Discussion is given on the theory, apparatus, and parameters of the quadrupole separator. A quadrupole field in which the electrodes are formed by groups of stretched wires was built. The wires are fastened only at the two ends of the field. This method of field construction can be directly applied to isotope separators. The technique has the advantage that there is no parameter in the entire apparatus which has to be adjusted mechanically when the field is replaced. The position of the ion source, as well as the position of the collector, with respect to the field axis is not critical since the entrance diaphragm is not focused on the collector as an optical image. Because of its lower capacity per meter, the wire system requires approximately 35% less h-f power than the conventional rod construction. (P.C.H.)

9107 DOUBLE MAGNETIC DEFLEXION ISOTOPE SEPARATOR FOR THE PRODUCTION OF VERY HIGH PURITY ISOTOPES. R. Bernas, J. L. Sarrouy, and J. Camplan (Université, Paris, Laboratoire de Physique Nucléaire, Orsay, France). p.121-40 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

The electromagnetic separator is made up of a 60° sector homogeneous magnetic field analyzer followed by a semicircular inhomogeneous field analyzer of the Svartholm Siegbahn type. The enrichment factors reached are from ten to a hundred times higher than those obtained with other separator types while the ion beam intensity remains in the neighborhood of 1 ma. A description of the instrument is given as well as the first results obtained in the separation of isotopes of a few elements: Cr, Sr, Yb, Hg, U, and Eu. (auth)

9108 RECENT MODIFICATIONS TO HERMES. R. W. McIlroy, J. H. Freeman, and K. J. Hill (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.155-65 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Recent modifications on Hermes are described. Preliminary runs with lead and uranium showed that the design requirements (high resolution at 1 mamp and 4% efficiency) could be met, and since plutonium isotopes were urgently required, active runs were begun without further delay. During continued plutonium separations, it was found that although the high enhancements could be maintained, the conditions for the best focus were extremely critical and difficult to maintain during the entire run (about 48 hr). Operating conditions could not readily be reproduced from run to run, the source efficiency varied from 0.5 to 8%, and the collection 150 μamp to 1.7 mamp. It was concluded that some of the difficulties experienced in operating Hermes can be attributed to perturbations of the source unit magnetic field, and also to the inadequate focusing of the ion beam by the extraction electrode system. (P.C.H.)

9109 SOME CHARACTERISTICS OF THE E.M. ISOTOPE SEPARATOR AT THE NOBEL INSTITUTE OF PHYSICS, STOCKHOLM. T. Alvaeger and J. Uhler (Nobel Inst. of Physics, Stockholm). p.166-72 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Some design details and the performance of the separator are described. Special attention is given to the possibilities of obtaining very high purity samples in a low-intensity single-stage separator. (P.C.H.)

9110 AN ION SOURCE FOR SHORT-LIVED RADIOACTIVE ISOTOPES AND PRELIMINARY RESULTS ON A DUOPLASMATRON TYPE ION SOURCE. J. L. Sarrouy and R. Klapisch (Université, Paris, Laboratoire de Physique Nucléaire, Orsay, France). p.184-92 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Discussion is given on ion sources presently being used or to be used in a short time in the double-deflection separator of Orsay for work on radioactive isotopes. A description of the ion source for the separation of mercury isotopes obtained by the bombardment of gold in the synchrocyclotron and the range of short-lived radioisotopes which may be processed in the source are given. Preliminary results are also given on a duoplasmatron type ion source. (P.C.H.)

9111 A METHOD OF RAPID ELECTROMAGNETIC SEPARATION OF RADIOACTIVE ISOTOPES. Jan Uhler and Torsten Alvaeger (Nobel Inst. of Physics, Stockholm). p.193-8 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Descriptions of technical solutions chosen and main factors influencing the decisions in the problem of separating activities with half lives as short as a few minutes are given. The results of some runs are also reported. A two-furnace system was found to be the best way to overcome the difficulties in separation. A symmetric arrangement makes it possible to supply the ion source with two identical furnaces. As a test of the technical solution chosen, carrier free Pb^{212} was separated as $PbCl_2$. (P.C.H.)

9112 SOME PROBLEMS RELATED WITH ION SOURCES FOR RADIOACTIVE ISOTOPES. P. Lazeyras (Centre d'Etudes Nucleaires, Saclay, France). p.199-203 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Description is given of an ion source for short-lived radioelements such as the rare earths. The source works on the sputtering arc principle and was used in a few separations of neodymium and praseodymium irradiated in a cyclotron. The basic principles of the design were found to be satisfactory; the internal efficiency appeared to be high. There was very little radioactivity inside the source after a run and the vacuum lock, which was designed for no auxiliary pumping, no disturbance in the source and the whole separator regime, and rapidity in operation, worked perfectly. However, the over-all efficiency was very poor. Discussion is also given on the compromise of efficiency and resolution. (P.C.H.)

9113 A PARALLEL FILAMENT LATERAL ARC SOURCE UNIT. J. H. Freeman (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.204-6 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

An electron impact source unit with the filament behind and parallel to the extraction slit and parallel to the focusing magnetic field was tested in an attempt to overcome the difficulties associated with the Hermes source unit. Well focused beams of krypton and argon were obtained with a strip tantalum filament (4 × 1 × 50 mm) placed 3 mm behind the extraction slit. The focus remained excellent over almost the whole range of outputs and arc conditions, and an excellent resolution was also obtained with the source magnet switched off altogether. Comparative measurements showed that the efficiency was approximately twice that of the conventional source unit. After 40 hr of operation under a wide variety of arc conditions, the filament showed little signs of wear. (P.C.H.)

9114 SPUTTERING EXPERIMENTS WITH THE AMSTERDAM ELECTROMAGNETIC ISOTOPE SEPARATOR. P. K. Rol, J. M. Fluit, and J. Kistemaker (F.O.M.-Laboratorium voor Massaspectrografie, Amsterdam). p.207-18 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

The sputtering ratio of polycrystalline copper is measured by bombarding with ions of many elements as a function of the ion energy and the angle of incidence. For copper monocrystals the sputtering ratio was measured for different crystal orientations as a function of the angle of incidence in bombardment with Ar^+-ions at 20 kev. An interpretation of the measurements is given on the basis of rigid sphere collisions of the ions in the lattice. It is supposed that excited regions, which emit the sputtered particles, are formed near the surface. (auth)

9115 COLLECTION AND SPUTTERING EXPERIMENTS WITH NOBLE GAS IONS. O. Almén and G. Bruce (Chalmers Univ. of Tech., Goteborg). p.219-26 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Collection and sputtering experiments made with a 90° electromagnetic isotope separator are described. Determinations of absolute values were made by comparing the activities from degassed foils and from known amounts of active gas. The accuracy of the absolute determinations was about 5% for Kr and Xe, and about 10% for Ne and Ar. A close relation was found between sputtering and saturation value. The explanation is that both the diffusion coefficient and the sputtering ratio depend on the same fundamental properties of a material. A periodicity was also observed in the curves. (P.C.H.)

9116 SPUTTERING BY IONS WITH 10–65 Kev ENERGY. O. Almén and G. Bruce (Chalmers Univ. of Tech., Goteborg). p.227-33 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Sputtering experiments made with a 90° electromagnetic isotope separator are described. The energy dependence of sputtering was investigated for more than 40 combinations of ion and target material. The target materials used were Cu, Ag, and Ta. Maximum sputtering ratios were noted for Ne, Ar, Kr, and Xe ions. Sputtering of the target material is sometimes zero. This means that the ions gradually build up a layer which protects the underlying material. Conditions are given for this. Most ions were found to have sputtering ratios between the ratios for noble gas ions for corresponding mass numbers and zero. However, most ions can be collected in quantities of at least a few $\mu g/cm^2$ with the direct collection method, and the final sputtering ratio indicates how much larger the saturation quantity is compared with that of a corresponding noble gas. It was also noted that elements other than the noble gases appear in similar positions on the sputtering curves. Temperature dependence of Sn sputtering on Cu was investigated and was found to be independent of temperature below 500°C. (P.C.H.)

9117 PREPARATION OF TARGETS AND RADIOACTIVE SOURCES IN AN E.M. SEPARATOR. G. Sidenius and O. Skilbreid (Universitet, Copenhagen). p.234-9 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Advantages and disadvantages are given for collecting isotopes by direct deposition of the ions and by sputtering. Designs are also given for various collection devices. A method is suggested for retarding the ions before collecting them. It was concluded that with this method, highly concentrated sources can be prepared for β spectroscopy. The main drawback of the method is that only one isotope of an element can be collected per run, but in the preparation of β sources, this drawback should not be important. (P.C.H.)

9118 E.M. SEPARATIONS WITH HIGH EFFICIENCY OF MICROGRAMME QUANTITIES. G. Sidenius and O. Skilbreid (Universitet, Copenhagen). p.243-9 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Reproducible separations of microgram amounts were obtained with high efficiency by the following method: The oxide to be separated is placed in a filter of quartz wool which first was placed into one end of a quartz tube. The other end of the quartz tube is connected to a stainless steel tube. By means of a vacuum lock the tube is inserted in the isotope separator and connected to the ion source so that the free end containing the oxide sticks about 5 mm into the discharge chamber. The gas inlet tube is connected to a CCl_4 container via a needle valve. As soon as the tube is placed in position, CCl_4 is fed into it. The rate of flow of CCl_4 is kept high enough to maintain a stable plasma in the ion source. After a few minutes, when the tube has reached a sufficiently high temperature, the oxide converts into chloride. The chloride then feeds directly into the discharge chamber. Elements 62 to 70 and Hf, W, Th, Pa, U, and Pu were separated by this method. (P.C.H.)

9119 SOME CHEMICAL PROBLEMS CONNECTED WITH THE ELECTRO-MAGNETIC SEPARATION OF ISOTOPES. A. E. de Vries (F.O.M.-Laboratorium voor Massaspectrografie, Amsterdam). p.250-6 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Discussion is given on problems encountered in the choice and purity of source material, collector material, processing of separated material, and analysis of the separated material. (P.C.H.)

9120 PRECAUTIONS WITH α-ISOTOPE SEPARATORS AT HARWELL. R. W. McIlroy (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.268-77 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Details are given of precautions taken in Hermes separation of plutonium. The machine is enclosed in a sealed, 500-ft^2 room joined on one side to the pressurized suit area of the radioactive chemical laboratory, and having the control room on the other side and separated from it by large double perspex windows giving a good side view of the machine from the control desk. All operations on the machine, which include maintenance and source and collector changing (but not assembly), are carried out by men in pressure suits controlled from the chemical laboratory service center but in telephonic communication with the Hermes control room. (P.C.H.)

9121 APPLICATIONS OF ELECTROMAGNETICALLY SEPARATED RADIOACTIVE ISOTOPES AT THE NOBEL INSTITUTE OF PHYSICS. PART I. Torsten Alvaeger (Nobel Inst. of Physics, Stockholm). p.279-84 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Discussion is given on measurements of short half lives by the use of delayed coincidences, search for very weak transitions, such as double-quantum emission, and mass determination of products obtained in heavy-ion reactions. Problems of current interest and isotopes which were separated are tabulated. The elements separated are mainly grouped around the double filled shells Z = 82, N = 126 and Z = 50, N = 82. (P.C.H.)

9122 APPLICATIONS OF ELECTROMAGNETICALLY SEPARATED RADIOACTIVE ISOTOPES AT THE NOBEL INSTITUTE OF PHYSICS. PART II. Jan Uhler (Nobel Inst. of Physics, Stockholm). p.285-91 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Discussion is given on low energy β spectroscopy and nuclear spectroscopy of uranium fission products. These two uses are intended to show that the existence of the separator can encourage research work on problems otherwise regarded as difficult. (P.C.H.)

9123 RECENT APPLICATIONS OF THE UPPSALA MASS SEPARATOR. G. Andersson (Univ. of Uppsala). p.292-9 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Characteristics, types of problems, and special experimental techniques concerned with the Uppsala separator are discussed. The Uppsala separator was applied to studies of relative yields from spallation and high energy fission reactions from the beginning. The use of the separator is based on the assumption that there are no mass discriminating effects among isotopes of the same element in the ion source or at the collector. The cumulated number of separations and of utilized samples are given as functions of time after the reconstruction of the ion source in 1956. The applications fall mainly within the fields of nuclear spectroscopy and reaction yield studies, the elements processed including Zn, Ga, As, Br, Kr, Te, I, Xe, Hg, Tl, and Pb. (P.C.H.)

9124 APPLICATIONS IN THE FIELD OF NUCLEAR PHYSICS OF THE ORSAY DOUBLE DEFLEXION ISOTOPE

SEPARATOR. R. Bernas (Université, Paris, Laboratoire de Physique Nucléaire, Orsay, France). p.300-6 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

A brief review is given of experiments done with the help of the first or both stages of the Orsay separator during its first year of operation. Possibilities of an instrument of this type are discussed rather than details of nuclear physics problems, which were studied. (P.C.H.)

9125 PREPARATION OF RADIOACTIVE SOURCES FOR β- AND γ-RAY SPECTROSCOPY BY ELECTROMAGNETIC ISOTOPE SEPARATION. O. B. Nielsen and O. Skilbreid (Institut for Teoretish Fysik, Copenhagen). p.307-10 of "Electromagnetic Separation of Radioactive Isotopes." Vienna, Springer-Verlag, 1961.

Problems related to the preparation of sources for nuclear spectroscopy are discussed. A number of experiments are described, which could not have been performed without the use of electromagnetic isotope separators. (auth)

9126 A PROCESS FOR THE SEPARATION OF ISOTOPES OF ALKALI METALS AND APPARATUS FOR CARRYING OUT THIS PROCESS. (to Commissariat a l'Energie Atomique). British Patent 888,884. Feb. 7, 1962.

A process and an apparatus are described for separating by counter-current electromigration the isotopes of alkali metals, especially lithium. The process comprises causing a stream of fused alkali nitrate to flow between an anode and a cathode counter-current to the cation electromigration at a speed between the speeds of the fastest and slowest cations, and regenerating the nitrate from the alkali metal deposited at the cathode by addition of nitric acid vapor. The passage between the cathode and anode compartments is filled with a packing of a powdered material to suppress convection currents. An embodiment of the apparatus is described for the separation of Li^6 and Li^7. (D.L.C.)

MATHEMATICS AND COMPUTERS

Refer also to abstract 9583

9127 (ANL-6447) GAMMA I. A GENERAL THEOREM-PROVING PROGRAM FOR THE IBM 704. John Alan Robinson (Argonne National Lab., Ill.). Nov. 1961. Contract W-31-109-Eng-38. 46p.

GAMMA I is a FORTRAN-compiled program for the IBM 704 Electronic Data-Processing Machine. It embodies a certain general, uniform procedure H of mathematical logic for seeking out a proof of any theorem within any mathematical theory which is given in formal axiomatic form. An extended discussion is provided of the underlying method and of the necessary background of mathematical logic. The program is described in detail. (M.C.G.)

9128 (CVNA-107) KERNMAT — A FORTRAN CODE FOR THE HETEROGENEOUS METHOD OF REACTOR CALCULATIONS. Sub-Task 2.01: Reactor Physics Analysis. S. A. Raje (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Sept. 1961. For Carolinas-Virginia Nuclear Power Associates, Inc., Charlotte, N. C. Contract AT(30-1)2289. 100p.

A code for performing reactor calculations by the heterogeneous method is developed in FORTRAN for use on the IBM-704/709/7090 computers. The basic (integro-differential) equations of the method are derived initially ignoring any fuel resonances and subsequently introducing single lumped resonances in fuel. Cylindrically symmetric fuel assemblies are assumed for which either simple age-diffusion kernels or their (empirical) linear combinations are built-in. Illustrating some simple lattice symmetries, a formulation of the matrix eigenvalue problem for a heterogeneous reactor is given. The FORTRAN listing of the main program is given, followed by a procedure sheet for input preparation. A sample problem with discussion of the input-output is given, and comparison made with a critical experimental eigenvalue measurement. An appendix contains description of a function subroutine for the exponential integrals developed for use in the code KERNMAT. A 32 K machine is required. Typical problem running times on 7090 are of the order of a couple of minutes. (auth)

9129 (DC-57-2-119) 650 PROGRAM FOR THERMODYNAMIC CORE DESIGN. B. Kaplan (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 22, 1957. Contract AT(11-1)-171. 35p.

The digital computer technique using the IBM 650 is presented for calculating the required heat transfer area, hydraulic diameter, free-flow area per stage, and the stage by stage pressure losses of reactor cores employing ribbon-type fuel elements, that will meet specified design parameters. The design parameters which serve as the input to the program are core inlet and exit air temperatures, tube inlet Mach number, inlet pressure, number of stages, trailing edge design fuel element temperature, fuel element plate thickness, stage length, the friction factor parameter, and power profile. By variation of the above input, the effect of other design parameters may be investigated. (auth)

9130 (DC-57-11-150) SPECIFICATIONS–SHIELDING COMPUTER PROGRAMS 14-0, 14-1, AND 14-2, REACTOR SHIELD ANALYSIS. W. E. Edwards (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 20, 1957. Contract AT(11-1)-171. 29p.

Specifications are presented for shielding computer Programs 14-0, 14-1, and 14-2. These programs can be used to compute reactor-shield assembly weight and can be applied in point kernel techniques for computation of neutron and gamma ray energy spectra, and dose and energy absorption rates in and around complex reactor-shield assemblies. The programs should provide enough physical and source description capability that nuclear analyses of reactor-shield assemblies currently considered at ANPD will involve little uncertainty except that associated with the point kernels. (auth)

9131 (GAMD-1766) FUELCYC-TH-3, A NEW VERSION OF THE FUELCYC-CODE INCORPORATING THE TH-232, U-235 HEAVY ISOTOPE BUILDUP CHAIN. C. Cyl-Champlin (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Oct. 24, 1960. Contract AT (04-3)-314. 55p.

A version of FUELCYC called FUELCYC-TH-3 was developed for application to HTGR analysis. This version of the code provides the same features of FUELCYC with the following differences: the $Th^{232}-U^{235}$ heavy isotope build up chain is used in place of the $U^{235}-U^{238}$ chain; radial zoning of the core is allowed to provide up to four radial variations in the initial fuel loading; and B^{10} may be included with or without self-shielding in each of the core zones as a "lumped" burnable poison. (auth)

9132 (HW-71545) COMPUTER CODE HFN-MULTIGROUP, MULTIREGION NEUTRON DIFFUSION THEORY IN ONE SPACE DIMENSION. J. R. Lilley (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 17, 1961. Contract AT(45-1)-1350. 55p.

The computer program HFN uses numerical methods to solve the homogeneous or inhomogeneous one-space-dimensional multigroup diffusion equation for its lowest eigenvalue and the corresponding direct and/or adjoint eigenvectors, in both multiplying and non-multiplying systems. Inhomogeneous boundary conditions combine with a flexible scatter-transfer matrix structure to permit HFN to solve a wide variety of problems, including some not directly associated with neutron diffusion theory. Optional calculations use the results of the diffusion theory solutions to perform criticality searches, compute detector activation traverses, and compute integrals of interest in perturbation theory analyses. The theory is described and the operating instructions are listed along with a sample problem which took ten seconds on an IBM-7090. HFN is coded in FORTRAN (95%) and FAP for a 32 K IBM-7090. (auth)

9133 (HW-72117) BARNS — A PROGRAM TO OBTAIN CROSS SECTIONS FROM THE RBU BASIC LIBRARY. J. E. Schlosser (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 27, 1961. Contract [AT(45-1)-1350]. 50p.

A computer program was developed to make the information in the RBU cross section data library available for other computer programs. Program BARNS exists in two versions, each of which will compute group averaged or point cross sections for an arbitrary array of energies. One version uses unit weighting of the cross sections during averaging while the other version uses a 1/E weighting. BARNS was coded in FORTRAN language supplemented by a few FAP subroutines for an IBM 7090 with a 32 K memory. A description is presented of each of the sub-

routines in the program. Instructions are given for preparing input to the present code. A dictionary of the variables in Common and a listing of the complete program are included. (M.C.G.)

9134 (NYO-9756) A NOTE ON THE CONVERGENCE OF ALTERNATING DIRECTION METHODS. Milton Lees (New York Univ., New York. Atomic Energy Commission Computing and Applied Mathematics Center). June 20, 1961. Contract [AT(30-1)-1480]. 16p.

Norm estimates are derived for the rate of convergence of the basic alternating direction methods for solving elliptic difference equations. The equations treated have variable coefficients and are defined in arbitrary regions. (auth)

9135 (SGAE-1961/4B) DAS RECHNEN MIT DEM IBM-MAGNETTROMMELRECHNER TYPE 650. II. TEIL. (Calculation with IBM-Magnetic Drum Calculator Type 650. Part II). H. Bruneder, M. Fischer-Colbrie, and P. Skarek (Österreichische Studiengesellschaft für Atomenergie G.m.b.H., Vienna). [1961]. 98p.

The index register and the floating-point arrangement are described. A subroutine for floating-point arithmetic is outlined. Pseudocodes are discussed including the system for interpretation of matrix operation (SIMO), the SOAP code, RUNCIBLE, and FORTRAN. Mathematical procedures are described for solutions to linear equation systems, algebraic characteristic functions, numerical interpolation and integration, numerical handling of differential equations, and the Monte Carlo Method. (M.C.G.)

9136 (TID-5900) STUDY OF TRANSIENT PERFORMANCE OF A NUCLEAR REACTOR WITH A DIGITAL PROGRAM. A. J. Arker and J. H. Helve (Knolls Atomic Power Lab., Schenectady, N. Y.). [1958?]. 19p.

A digital computer program (SPY) for predicting detailed reactor transient responses is described. The reactor model and flow redistribution are discussed. Examples of the application of the program to power plant design are given. (D.L.C.)

9137 (TID-14479) TECHNICAL PROGRESS REPORT. PART I. HIGH-SPEED COMPUTER PROGRAM. PART II. CIRCUIT RESEARCH PROGRAM. PART III. MATHEMATICAL METHODS. PART IV. DATA REDUCTION METHODS. PART V. ILLIAC USE AND OPERATION. PART VI. IBM 650 USE AND OPERATION. PART VII. INSTRUCTIONAL USE OF COMPUTERS. PART VIII. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). Oct. 1961. Contract AT(11-1)-415. 61p.

Progress is reported on high-speed computer development, circuit research, mathematical methods, data reduction methods, Illiac use and operation, IBM 650 use and operation, instructional use of computers, and general laboratory information. (M.C.G.)

9138 (UCRL-6649) BACKWARD MONTE CARLO AND OTHER METHODS FOR "REVERSING" STOCHASTIC PROCESSES. Edward L. Kaplan (California. Univ., Livermore. Lawrence Radiation Lab.). Oct. 2, 1961. Contract W-7405-eng-48. 21p.

When a stepwise Monte Carlo calculation is such that it has to terminate in a very restricted region in order to contribute to the result, it is known that a gain in efficiency may be achieved if the problem is reformulated so that the calculations can begin in the restricted region. The resulting backward Monte Carlo is discussed in terms of matrices and neutron transport; it corresponds to taking the transpose of the matrix of transition probabilities, and is contrasted with the inverse of such a matrix and the inverse probabilities calculated according to Bayes' theorem. It is shown that in anisotropic scattering, the azimuthal angle is uniformly distributed in the backward process as well as in the forward process. A pair of zero-variance sampling schemes that are related to Bayes' theorem is discussed. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

9139 (BM-RI-5851) HAFNIUM ELECTROREFINING. J. R. Nettle, J. M. Hiegel, and D. H. Baker, Jr. (Bureau of Mines. Boulder City Metallurgy Research Lab., Nev.). June 1960. 22p.

Results of studies to determine the feasibility of refining low-grade Hf are presented. An inert-gas-shielded molten-salt electrorefining technique was used to produce reactor grade Hf. The method was shown to be feasible. General criteria for refining off-grade Hf sponge are included. (J.R.D.)

9140 (CNEN-98) SCELTA E PREPARAZIONE DEI CAMPIONI METALLURGICI PER LA PRIMA ESPERIENZA D'IRRAGGIAMENTO NEL REATTORE ISPRA-1. (Selection and Preparation of Metallurgical Specimens for the First Irradiation Experiment in the Ispra-1 Reactor). G. Cogliati, C. Fizzotti, and F. Saraceno (Parsons (C. A.) and Co., Ltd., Newcastle-upon-Tyne, England). Nov. 1961. For Italy. Comitato Nazionale per l'Energia Nucleare, Ispra. 23p.

The criteria are described by which a series of U specimens in various metallurgical conditions, for use in irradiation studies, are chosen. The effects of thermal cycling concomitant with irradiation, and of grain size on irradiation growth and swelling, are to be investigated. The various operations carried out for the preparation of test specimens, such as dilution of enriched U and thermal treatment in order to obtain the required metallurgical structure, are described. (auth)

9141 (NMI-2101) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report, November 1961. (Nuclear Metals, Inc., Concord, Mass.). Jan. 25, 1962. Contract AT(30-1)-2784. 14p.

Preparation methods for refractory metal and alloy (Mo, W, and Hf–Mo) ingots, in preparation for studies of their high-temperature properties, are reported. The corrosion of zirconium-oxide-coated Zr and Zircaloy-2 by HCl is studied. The oxide film is deposited by heating the sample in O_2 or steam. The incorporation of small amounts of foreign ions (Nb, Si, Ti, Ta, and Al ions) into the oxide film, as exemplified by the reaction $SiCl_4 + ZrO_2 \rightarrow SiO_2 + ZrCl_4$, is accomplished. The relative irradiation-induced swelling characteristics of α- and β-phase U in the unalloyed state, in U–0.3 wt.% Cr, and in U–0.3 wt.% Cr–0.3 wt.% Mo are analyzed. The preparation of Be single crystals by zone refining, and the analysis of the crystals thus formed, are discussed. (T.F.H.)

9142 (NP-11264) CARBONIZATION OF PLASTICS AND REFRACTORY MATERIALS RESEARCH. VOLUME II. REFRACTORY MATERIALS. Sixth Quarterly Progress Report, October 1, 1961–December 31, 1961. Including Report of Progress During July 1, 1961–September 30, 1961. G. M. Kibler and T. F. Lyon (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Dec. 31, 1961. Contract AF33(616)-6841. 42p.

An apparatus for measuring the pressure of a permanent gas over a condensed phase by the Knudsen effusion method is described and preliminary measurements of the N_2 pressure over ZrN are reported. Work on the spectral properties of refractory materials is described. The spectral emissivity of NbB_2 was measured at 1540 to 2000°K. (D.L.C.)

9143 (NYO-2695) NUCLEAR FUEL RESEARCH; FUEL CYCLE DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT, JULY 1 TO SEPTEMBER 30, 1961. (United Nuclear Corp. Fuels Div., New Haven). Nov. 22, 1961. Contract AT(30-1)-2374. 24p.

The irradiation testing of UO_2 pellets prepared by low-temperature inert-atmosphere sintering, to irradiations of 10,000 Mwd/t, is discussed. Techniques for carburizing U–4.4 wt.% C and U–4.8 wt.% C mixtures into UC are reported. Methods for sintering, compacting, arc melting, casting, and grinding of the UC are described. The thermal expansion of the UC is determined. (T.F.H.)

9144 (WADD-TR-60-782(Pt.III)) VAPORIZATION OF COMPOUNDS AND ALLOYS AT HIGH TEMPERATURE. PART III. MASS SPECTROMETRIC STUDIES OF THE MOLECULES BC_2 IN THE VAPOR ABOVE THE SYSTEM BORON–CARBON. Georges Verhaegen, Fred E. Stafford, and Marcel Ackerman (Brussels, Université). Aug. 1961. Contract AF61(052)-225. 10p.

The molecules BC_2 and B_2C are identified in the vapor from graphite Knudsen cells containing B. The atomization energy $D_0^0(B\text{-}C\text{-}C)$ is found to be 297 ± kcal/mole. (auth)

9145 CHEMICAL VAPOR DEPOSITION OPENS NEW HORIZONS IN CERAMIC TECHNOLOGY. J. M. Blocher, Jr. and J. H. Oxley (Battelle Memorial Inst., Columbus, Ohio). Am. Ceram. Soc. Bull., 41: 81-4(Feb. 1962).

Consideration is given to some of the applications of chemical vapor deposition in the ceramic field, such as the coating of extended surfaces and the production of high-purity ceramics and coated powders. Some interesting characteristics of vapor deposition are discussed; the ability to form ceramic materials at temperatures below those normally encountered in ceramic technology and the possibility of thermodynamic control of the deposition reaction to establish the character of the solid phase deposited. (P.C.H.)

9146 THE PRODUCTION OF METALLIC NIOBIUM FROM AN OXIDE–CARBIDE MIXTURE. G. P. Shveykin and P. V. Gel'd. Tsvetnye Metally, 34: No. 4, 39-42(1961).

Results of studies of the reaction at atmospheric pressure and the composition of the intermediate products are presented. The starting materials were niobium pentoxide and acetylene black. The first stage of the two-stage process for the thermal production of niobium is the production of niobium carbide from niobium pentoxide and carbon: $Nb_2O_5 + 5C = 1.42NbC_{0.8} + 0.573NbO_2 + 3.854\ CO$. Experiments were carried out in a resistance furnace. The kinetics were followed by the decrease in weight. Metallic niobium was prepared in a laboratory vacuum furnace. The effect of temperature (°C) on the kinetics of the reaction at atmospheric pressure [decrease in weight of the charge (niobium pentoxide and carbon) in relative units] is illustrated. The reaction begins at 900°C. The loss in weight increases with increasing temperature up to 1300°C. The phase analysis of the products of reduction is given. For the preparation of metallic niobium, niobium pentoxide was added (5% excess). The charge was carefully mixed and a 9% solution of rubber in benzene was added. The mixture was pressed into mouldings with 4.5 T/cm^2 and they were dried at 120°C. It was found necessary to

give a preliminary heat-treatment to the mouldings at 1350-1400°C in an argon atmosphere to give sufficient strength and conductivity. The samples could then be heated by high frequency induction or by electrical current. By heating to 1450-1500°C in vacuo, holding at this temperature for 30 minutes and increasing the temperature to 1750°C, porous mouldings of metallic niobium containing 99.4-99.8% Nb, 0.5-0.1% C and less than 0.1% O_2 were obtained. (OTS)

9147 OSNOVY AVTOMATIZATSII TEKHNOLOGICHESKIKH PROTSESSOV GIDROMETALLURGII REDKIKH I RADIOAKTIVNYKH METALLOV. (Fundamentals of Technological Automation in Rare and Radioactive Metal Hydrometallurgy). G. N. Balasanov—V. N. Petrov, ed. Moscow, State Publishing House of Literature on Nuclear Science and Technology, 1960. 295p.

The technology of automation and the calculation methods for designing automatic operations in rare and radioactive metal hydrometallurgy are described. 196 references are included. (R.V.J.)

9148 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF DELTA ZIRCONIUM HYDRIDE. (to U. S. Atomic Energy Commission). British Patent 889,153. Feb. 7, 1962.

A method is outlined for preparing sound shaped bodies of delta-phase zirconium hydride. The method comprises cleaning the surface of a zirconium metal body of the desired shape, heating the cleaned body to a temperature of ≥1000°C, providing a hydrogen atmosphere around the body at a pressure not greater than one atmosphere to form beta hydride, reducing the temperature slowly to 800°C so that cracks do not form in the body while the beta phase is transformed into the delta phase, and cooling to room temperature in a hydrogen atmosphere. (D.L.C.)

Corrosion

9149 (ARDE(MX)-89/60) THE RESISTANCE TO OXIDATION OF NICKEL–CHROMIUM ELECTRODEPOSITS ON MOLYBDENUM. C. Williams and R. A. F. Hammond (Gt. Brit. Armanent Research and Development Establishment, Fort Halstead, Kent, England). Dec. 1960. 28p.

Methods of electrodepositing nickel and chromium on cylindrical testpieces of 0.5 per cent Ti–molybdenum alloy are described and the results of oxidation tests at 1100°C of various combinations and thicknesses of multilayer coatings of nickel and chromium are presented. Oxidation lives of 0.005 inch thick coatings typically range from 300 to 500 hr under conditions of limited daily cycling from 1100°C to ambient temperature. Measures to increase the chromium content of the outer zone of the diffused coatings were found to be effective in increasing the life and also appeared to improve the reproducibility. A four-fold increase in life to 1200 hr was achieved by applying a 0.003 inch top-coat of sprayed alumina. The modes of failure of the coatings are described and discussed. (auth)

9150 (HW-62875) AUTOCLAVE CORROSION BEHAVIOR OF U-LOW CARBON AND U-LOW ZIRCONIUM ALLOY FUELS. J. W. Goffard (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1, 1959. Contract AT(45-1)-1350. 12p.

"Open-end" corrosion tests in an induction heated autoclave at 200 and 300°C at 1500 psi were made on a series of coextruded Zr-2 clad U–C alloys (~30 to 1700 ppm C) and a series of coextruded Zr-2 clad U–Zr alloys (~0.05 to 2.00 wt % Zr). Variation in C content did not appear to affect significantly the over-all corrosion rates of the U–C alloys. Perhaps the most significant effect of C was that produced by the amount and distribution of UC inclusions in the extruded material. The corrosion resistance of U–Zr alloys was improved by increasing the Zr content. This improvement was more pronounced at 200°C than at 300°C. The effectiveness of Zr additions was reduced by C contamination. Perhaps the most significant effect of Zr in the low addition range was its influence on the nature of carbide inclusions in the extruded material. (auth)

9151 (HW-68613) FRETTING CORROSION OF PRTR FUEL ELEMENTS AND PROCESS TUBES. A. P. Larrick (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 14, 1961. Contract AT(45-1)-1350. 18p.

Two tests were run in the ELMO-7 loop to determine if fretting corrosion of Zircaloy-2-clad PRTR fuel elements would be a serious problem during PRTR operation. The tests were made on a single-rod dummy PRTR fuel element and on a full-size 19-rod cluster PRTR fuel element suspended in a PRTR process tube with water flow. After test periods up to 75 days, fretted areas of 5 to 7 mils deep were found in the cladding and process tube. The results considered with those of earlier tests indicate that fretting will not be a serious problem in the PRTR. (D.L.C.)

9152 (HW-71756) OBSERVATIONS ON THE MECHANISMS AND KINETICS OF AQUEOUS ALUMINUM CORROSION II. R. L. Dillon (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 1961. Contract AT(45-1)-1350. 18p.

Values of the rate constants for the linear corrosion process in water were determined for 1245 alloy aluminum, and are presented as a function of temperature. Time to rate transition was determined and is presented as a function of temperature and heat treatment. It is shown that the accelerated linear attack is not necessarily intergranular in character. (auth)

9153 (MND-E-2681) LOOP TESTING OF INCONEL, NICKEL, MONEL AND BIMETAL HEAT EXCHANGERS. ANPP CORROSION PROGRAM. J. McGrew and E. Jules (Martin Co. Nuclear Div., Baltimore). Dec. 1961. 94p.

A description is given of corrosion tests performed on 12 test vessels. Two sets of model heat exchangers (a set consists of a steam generator and superheater) and eight miniature heat exchangers were tested dynamically in a pressurized water loop. One set of model heat exchangers had bimetal tubes (stainless steel in the primary, carbon steel in the secondary) and the other had Inconel tubes. The set with bimetal tubes was service tested for 4890 hours and that with Inconel tubes was service tested 4747 hours. The secondary environment in the bimetal vessels simulated the SM-1 water conditions while the secondary in the Inconel vessels simulated reactor quality water. Two of the miniature heat exchangers, MIN 10 and 11, had Inconel tubes, MIN 13 and 14 had Monel tubes, MIN 15 and 16 had bimetal tubes and nickel tubes were used in MIN 18 and 19. The test durations for the miniature heat exchangers, MIN 10, 11, 13, 14, 15, 16, 18, and 19, were 3045, 3024, 1393, 1418, 3015, 3035, 1385, and 1350 hours, respectively. The Inconel, nickel, and Monel tubing performed well in both reactor grade and high chloride secondary water. Pitting occurred in all three metals but was less prevalent in the Inconel tubing. The Inconel tubing in the model vessels exposed to reactor grade water did not pit. The bimetal

model vessels, which were tested using reactor grade water, performed far better than similar vessels exposed previously to a high chloride secondary environment. Nevertheless, the degree of pitting which occurred was prohibitive for long-life steam generators. Tubing in one of the bimetal miniature vessels was defected to expose stainless steel to the high chloride secondary environment. The hypothesis, that the carbon steel provides cathodic protection and prevents stress corrosion cracking of the stainless steel, was supported by the test results; no cracking of the stainless sublayer occurred. However, complete substantiation should be based on further tests. (auth)

9154 (TID-14777) STUDIES ON THE OXIDATION OF COBALT IN THE TEMPERATURE RANGE 920°–1200°C. Frederick S. Pettit and J. Bruce Wagner, Jr. (Yale Univ., New Haven. Hammond Metallurgical Lab.). Jan. 23, 1962. Contract [AT(30-1)-2495]. 78p.

The oxidation of pure cobalt and cobalt containing small amounts of impurities was studied in air, oxygen, CO_2, and in $CO-CO_2$ mixtures in the temperature range of 920° to 1200°C. The kinetics of oxidation were determined by using an automatic recording vacuum balance. The mechanism of oxidation was ascertained through the analysis of kinetics and by marker studies, x-ray analysis, and metallographic examination of oxidized specimens. The oxidation kinetics of pure cobalt were parabolic for oxidation in air and oxygen. Oxidation in CO_2 and in $CO-CO_2$ mixtures resulted in linear kinetics for oxide thicknesses less than 7.3×10^{-4} cm and parabolic kinetics for greater oxide thicknesses. The mechanism of oxidation was determined to be the diffusion of cobalt ions through the oxide. For the linear regions of oxidation observed in the case of oxidation in $CO-CO_2$ mixtures, the oxidation rate, for oxide thicknesses between 4×10^{-6} and 7.3×10^{-5} cm, was found to be a linear function of the mole fraction of CO_2 in the gas phase for temperatures between 1000° and 1200°C and 1 atm pressure. These data confirmed the rate determining step for the process to be dissociation of carbon dioxide into carbon monoxide and adsorbed oxygen atoms or ions in accordance with a mechanism proposed by C. Wagner for the oxidation of iron in $CO-CO_2$ mixtures. Small amounts of impurities drastically altered the kinetics and the mechanism of oxidation of cobalt. The impurities affected the kinetics and mechanism of oxidation through alteration of the mechanical properties of the oxide. (auth)

9155 (TID-14852) AN INFRARED INVESTIGATION OF CORROSION FILMS FORMED ON POTASSIUM BROMIDE AND SODIUM CHLORIDE BY IODINE PENTAFLUORIDE (thesis). David Paul Hosler (Vanderbilt Univ., Nashville, Graduate School). June 1958. 40p.

The infrared absorption spectra of the films formed on potassium bromide and sodium chloride by corrosion with iodine pentafluoride were investigated for the purpose of determining the identity and structure of the new compounds. It was concluded that the bands observed were from the cation IF_6 (in the form of KIF_6 and $NaIF_6$) but the band in the NaCl region appeared at a higher frequency than was expected from comparison with an octahedral molecule such as TeF_6. It was concluded that IF_6^- is not a regular octahedron. (M.C.G.)

9156 (TID-14955) INTERMEDIATE-TEMPERATURE OXIDATION OF BERYLLIDES. Monthly Letter Report No. 5, January 1, 1962–February 1, 1962. Frank C. Perkins (Denver. Univ. Denver Research Inst.). Feb. 8, 1962. Contract AT(11-1)-1092. 4p.

Heat treatments confirmed the susceptibility of Nb_2Be_{17} to accelerated oxidation attack in the sensitive temperature range. Gas flow was provided by cylinders of compressed gases for oxygen or argon and a mechanical pump for air. The specimen is contained in a recrystallized alumina crucible. The weight-gain versus time curve obtained on isothermal annealing of Nb_2Be_{17} at 1600°F in moist air was linear. Metallographic and x-ray diffraction studies were performed in order to help explain the surface mechanisms of catastrophic oxidation. Specimens of $ZrBe_{13}$, Zr_2Be_{17}, and Nb_2Be_{17} were submitted for an x-ray determination of lattice parameters. (M.C.G.)

9157 (AEC-tr-5008) AN ELECTROCHEMICAL METHOD FOR INVESTIGATING THE ATMOSPHERIC CORROSION OF METALS. G. B. Klark, M. I. Mikhailovskaya, Yu. N. Mikhailovskaya, and N. D. Tomashov. Translated by Lydia Venters (Argonne National Lab., Ill.) from Trudy Inst. Fiz. Khim., Akad. Nauk S.S.S.R., No. 7, 11-21(1959). 14p.

The corrosion of metals by pure or contaminated air is studied, for cases in which a film of water vapor is adsorbed onto the metallic surface. The relative humidity is restricted to values ≤100%. Experimental results are given for the corrosion of Cu and Zn, by air at relative humidities of 75 to 100% and containing 0 to 0.5% SO_2. (T.F.H.)

Fabrication

9158 (ASD-TR-61-461) ELECTRON BEAM WELDING OF TUNGSTEN AND MOLYBDENUM. Harry A. Hokanson and William I. Kern (Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.). Sept. 1961. Contract AF33(616)-7439. 104p.

Techniques for the high-voltage electron beam welding of pure tungsten and arc-cast molybdenum–0.5% titanium were developed and evaluated. Welds were produced in sheet thicknesses of 0.005, 0.050, and 0.100 in. for each material. Primary emphasis was placed on producing butt welds of maximum strength and ductility. Limited work was also performed on lap, seam, edge, and spot welding. The effects of various welding conditions on weld-zone characteristics were evaluated by visual, radiographic, fluorescent penetrant, and metallographic inspection. Welds were inspected for extent of fusion and recrystallization, grain size, cracking, porosity, and other pertinent effects. Butt welds of each thickness exhibiting optimum weld-zone characteristics were evaluated for mechanical properties. Weld ductilities were determined by transverse bend testing at temperatures to 1200°F. Weld tensile properties were determined at room temperature and at temperatures to 2800°F. Results of the metallographic and mechanical property investigations of the electron beam welds were compared with base-metal properties and with published data for other joining techniques. (auth)

9159 (DC-54-4-71) PRELIMINARY OPERATING MANUAL–FABRICATION OF NICHROME V FUEL RIBBON. (General Electric Co. Aircraft Nuclear Propulsion Dept. Cincinnati). Apr. 21, 1954. Contract AT(11-1)-171. 68p.

Operations concerned with fabrication of Nichrome V fuel ribbon are presented in the form of a procedures manual. The procedures are to be used as a guide in pilot line operations in the L-6 area. (auth)

9160 (DC-57-2-115) MANUAL OF FABRICATION PROCEDURES FOR THE ASSEMBLY OF FUEL ELEMENT CARTRIDGES. G. T. Muehlenkamp (General Electric Co. Aircraft Nuclear Propulsion Dept. Cincinnati). Feb. 18, 1957. Contract AT(11-1)-171. 35p.

Fabrication procedures starting with those for forming of rings are presented. The procedures are applicable to fabrication of Project 101 fuel element cartridges. (J.R.D.)

9161 (DC-59-2-86) PROGRESS REPORT, [ON] EDGE SEALING OF Ni–Cr FUEL STOCK BY FUSION WELDING. C. S. Wukusick (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 6, 1959. Contract AT(11-1)-171. 16p.

A method of edge sealing Ni–Cr fuel stock by fusion welding was developed. Procedures and test results are presented. (auth)

9162 (DMIC-Memo-143) NOTES ON THE FORGING OF REFRACTORY METALS. H. J. Henning and F. W. Boulger (Battelle Memorial Inst., Columbus, Ohio). Dec. 21, 1961. 52p.

The forging characteristics of Mo, W, Nb, and Ta alloys are summarized. Forging practices and the availibilities of various forgings are reviewed. Alloys of Mo with W, Ti, Zr, and Nb; of W with Mo and Th; of Nb with W, Ti, Mo, Zr, and Ta; and of Ta with W, Hf, Nb, and V are studied. A bibliography of 35 references is included. (T.F.H.)

9163 (EURAEC-117) FABRICATION OF OXIDE FUEL ELEMENTS USING THE SWAGING PROCESS. Fourth Quarterly Report. Progress Report for the Period from April 1 to June 30, 1961. Appendix 2 to NUKEM Letter to Euratom of July 31, 1961. F. Hofmann, H. Kroll, and B. Liebmann (Nuklear-Chemie und Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). Work performed under United States-Euratom Joint Research and Development Program. Contract [011-60-SRDA]. 8p.

Activities during the period were devoted mainly to tests aimed at increasing the tamp density. Improvements of about 10% were obtained. Densities exceeding 94% T.D. were obtained with melted powder by swaging. Swaging densities of 90% T. D. were obtained using unmelted powder. (J.R.D.)

9164 (HW-68493) OXIDATION OF GRAPHITE UNDER HIGH TEMPERATURE REACTOR CONDITIONS. R. E. Dahl (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 1961. Contract AT(45-1)-1350. 38p.

A kinetic study was conducted to provide information on oxidation of reactor graphites in the temperature range of 450 to 675°C and on the effects of reactor environment on oxidation rates. Among the parameters studied were chemical reactivity of the graphite, prior oxidation, a high intensity gamma flux during oxidation, variation of the surface-to-volume ratio of the graphite specimens, neutron bombardment prior to oxidation exposure, and gas flow rates. Rate equations showed apparent activation energies of 50 kcal/mole in the absence of radiation and 30 kcal/mole in the presence of a 1×10^6 r/hr gamma flux. (auth)

9165 (HW-69401) METALLOGRAPHIC STUDY OF THE ANNEALING BEHAVIOR OF ALUMINUM–SILICON EUTECTIC ALLOY. R. H. Todd (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1961. Contract AT(45-1)-1350. 61p.

The response of a eutectic Al–Si alloy to a series of time-temperature anneals was studied metallographically. The alloy layer between brazed aluminum components, and a casting of the eutectic alloy were investigated. Spheroidizing behavior of the acicular Si particles in the alloy was determined at 250 to 550°C for periods up to 100 days. A chart depicting the microstructural appearance of the eutectic Al–Si alloy at successive annealing stages is presented. Each annealing stage was assigned an arbitrary number termed the annealing value. A particular annealing value could be attained through a wide variation of time and temperature conditions but for a given "annealing value" only one of these conditions is independent; the choice of one fixes the other. Thus the annealing value can be used to estimate the mean effective temperature to which a sample has been exposed provided the duration of exposure is known. An Arrhenius plot of the thermal histories of samples having equal annealing values indicated that the spheroidizing of Si particles is a diffusion-controlled mechanism. The activation energy of the alloy for this process was determined to be 37,700 calories per gram mole for both the braze layer and the cast forms of the alloy. (auth)

9166 (KAPL-2171) CONTROL OF FISSURING IN INCONEL BY REGULATING PROCESS VARIABLES. J. D. Carey and G. F. McKittrick (Knolls Atomic Power Lab., Schenectady, N. Y.). Sept. 18, 1961. Contract W-31-109-Eng-52. 29p.

The detection of fissures, the identification of constituents producing fissures, and the means of preventing their formation are discussed, for Inconel welds. It is found that energy input alone does not measurably affect the degree of fissuring. A study of postweld heat tratments as a means of eliminating fissures is conducted. Various stringer bead and weaving techniques are evaluated. The weaving shows a substantial decrease in the number of fissures observed in subsequent bend tests. X-ray diffraction and electron microscope studies identify grain boundary constituents, such as niobium carbide, that may promote fissuring. (auth)

9167 (KAPL-M-JVM-2) BELLMOUTHING OF THREADED JOINTS. Julius A. Mirabal (Knolls Atomic Power Lab., Schenectady, N. Y.). Dec. 1961. Contract W-31-109-Eng-52. 27p.

The "bellmouthing" of cylinders due to the transfer of the axial load across a threaded joint is treated. Design curves are given for the maximum deflection and maximum membrane stress, as well as the distribution of the membrane and bending stresses as functions of the material properties, dimensions and load. The threaded cylinder is assumed thin and semi-infinite with a thread height which is negligible compared with its wall thickness. An analysis of the effects of the radial load in relation to the angle of the thread height and friction is included. (auth)

9168 (KAPL-M-WAO-13) FABRICATION ON INCONEL-CLAD COPPER ROTOR DAMPING COILS. W. A. Owczarski and J. F. Bollinger (Knolls Atomic Power Lab., Schenectady, N. Y.). Nov. 17, 1961. Contract W-31-109-eng-52. 54p.

Inconel-clad copper, rectangular motor damping coils were fabricated by a combination of brazing and welding. The four corners were made as miter joints, brazed using gold filler metal, and then seal-welded to completely enclose the copper core using an Inconel-type filler wire and tungsten inert gas arc welding. Attachment lugs were readily welded on finished coils by the tungsten inert gas arc welding process with Inconel-type filler wire addition. Post-weld forming and machining did not damage the corner miter joints. Thermal cycling tests produced no apparent defects on the coil other than a slight lengthwise bow and twist. (auth)

9169 (NMI-4771) THE EXTRUSION OF METALLURGICALLY BONDED TUBULAR TRANSITION JOINTS BETWEEN FIREBOX STEEL AND ZIRCALOY-2. Final Report for the Period August 16, 1959 to June 30, 1961.

W. B. Tuffin (Nuclear Metals, Inc., Concord, Mass.). Jan. 23, 1962. Contract AT(30-1)-1562. 16p.

An extrusion process is described, by which a metallurgically bonded tubular joint between firebox steel and Zircaloy can be obtained. Data on bond strength and corrosion resistance are given. (auth)

9170 (NP-11238) FABRICATION OF BERYLLIUM FINE WIRE. Final Report. Technical Report 200-228. A. G. Gross, Jr., R. G. O'Rourke, and W. W. Beaver (Brush Beryllium Co., Cleveland). Apr. 1961. Contract NOas-60-6108-C. 62p.

Techniques were developed for the fabrication of beryllium (S-200B) fine wire and to establish optimum mechanical properties. Various lubricants and drawing temperatures were evaluated. Certain metal-sulfur compounds in conjunction with graphite were found to be the best solid-film combinations. An oil was found which would lubricate at temperatures up to 600°F in room atmosphere. Wire diameters as small as 0.00477 inch were produced with each lubrication system. Reductions in area as high as 99.41% without intermediate stress relief were made at 800°F, using the solid-film lubrication. A pickling technique was found which enhanced the bending properties of beryllium wire. The bend testing showed beryllium wire of commercial chemical purity to be ductile so long as the applied stress was rotationally asymmetrical about the wire axis. Tensile testing revealed that strength levels in the vicinity of 200,000 psi were attainable and that tensile strength was a function of reduction ratio from the last anneal and of a drawn diameter but was not a function of pickled diameter. An appreciable amount of twinning, $\{10\bar{1}2\}$, was produced as a result of drawing and these twins were not always destroyed by heat treatment. Little or no random recrystallization was produced by the annealing treatments employed. (auth)

9171 (NP-11284) TANTALUM EXTRUSION PROGRAM. Second Interim Technical Report, April 10, 1961 – August 24, 1961. (Wah Chang Corp., Albany, Ore.). Contract AF33(600)-42396. 71p.

Five different starting materials were used to evaluate the vacuum arc melting and electron beam melting parameters to determine optimum consolidation procedures. The most promising method for the production of sound extrusion billets was a three-step melting process. This consisted of vacuum arc melting 2.5-inch diameter presintered sodium-reduced Ta–10% W electrodes into a 5-inch diameter crucible. This material was then electron beam melted to insure maximum purity in the ingot. The electrode for the third melt consisted of two welded 5-inch diameter electron beam melted ingots. This electrode was vacuum arc melted into an 8-inch diameter ingot. One cast and seven wrought Ta–10% W billets were produced from electron-beam ingots and extruded at temperatures between 3150 and 3650°F and at extrusion reductions of 11.8:1 and 17.3:1. It appears that extrusion temperatures above 3650°F are required to make the desired Tee shape (17.3:1 reduction) from a 3⅞-inch diameter liner. The extrusion constant at 3650°F is approximately 70,000 psi. In the initial extrusion, the data obtained were not adequate to determine any significant difference between cast and wrought material. (auth)

9172 (NP-11351) A STUDY OF EXPLOSIVE FORMING SELECTED REFRACTORY METALS. Progress Report No. 4, November 1, 1961 through December 31, 1961. (Chromalloy Corp. Propellex Chemical Div., Edwardsville, Ill.). Jan. 30, 1962. Contract NOw 61-0832-c. 19p.

Strain rate data were obtained for Mo–½% Ti and for W. In order to affirm the results of the strain rates derived from the inductance measurements of blank velocity, comparison tests were made on AM350 stainless steel blanks. The explosive forming characteristics of W were also investigated. (M.C.G.)

9173 (ORO-515) FUEL CYCLE DEVELOPMENT PROGRAM MONTHLY NEWSLETTER, SEPTEMBER 1961. M. A. Bobal (National Carbon Co., Fostoria, Ohio). Oct. 29, 1961. Contract AT(40-1)-2560. 9p.

Migration experiments on graphite–5 wt.% UO_2 compacts, heated at 1400 to 1800°C for 235 hours, are discussed. The dispersion of ThO_2 in graphite is determined as a function of the wetness (i.e., the pitch content) of the mixture. A method is described for dispersing UO_2 shot, by mixing UO_2, graphite, pitch (25 pph), and trichloroethylene, and allowing the trichloroethylene to evaporate. The physical properties of extruded resin-bonded graphite–UC_2 fuel rods, containing 5 and 23 wt.% U, are outlined. The variations of U (or Th) composition with position in each of the mixtures studied are determined. (T.F.H.)

9174 SLIP CASTING CALCIUM OXIDE. R. E. Cowan, S. D. Stoddard, and D. E. Nuckolls (Los Alamos Scientific Lab., N. Mex.). Am. Ceram. Soc. Bull., 41: 102-4(Feb. 1962).

A procedure for slip casting calcium oxide, which was similar to that used for other oxides, was developed. Due to the hydration tendency of calcium oxide it was necessary to use fused or calcined material and a nonaqueous suspending agent. Isobutyl acetate was found to be a satisfactory casting vehicle. Additions of oleic acid and triethanolamine were necessary to reduce the viscosity of the slip, and firing was accomplished in either oxidizing or reducing atmospheres. High density calcia was found to have excellent hydration resistance. The results of tensile strength measurements are reported. (auth)

9175 METALLOGRAPHIC STUDIES OF Al–Ni–U BONDS IN NUCLEAR FUEL ELEMENTS. C. L. Angerman (E. I. du Pont de Nemours & Co., Aiken, S. C.). Am. Soc. Metals, Trans. Quart., 54: 260-75(Sept. 1961).

Reactor fuel elements fabricated by bonding aluminum to nickel-plated uranium are investigated by optical and electron metallography and by x-ray diffraction in order to study their diffusion zones and the relationship between the microstructure of the bonds and their strength and corrosion resistance. The two aluminum-nickel zones in the bonded fuel elements are identified as Al_3Ni and Al_3Ni_2, and the two nickel-uranium zones are identified as U_6Ni and UNi_5. An oxide, believed to be either UO_2 or a U-Ni-O ternary compound, is observed either as a dispersed phase within the UNi_5 zone or as a continuous layer between the U_6Ni and UNi_5 zones. The dispersed form of the oxide is observed to coalesce into a continuous layer and finally to dissolve during prolonged annealing. The limiting factor in the quality of the bonds is the presence of this oxide within the Ni-U portion of the bond. When the oxide occurs as a continuous layer, the strength of the bond averages less than 10000 psi and the bond is rapidly undercut during the pinhole corrosion test. When the oxide occurs as dispersed particles, the strength averages greater than 15000 psi and the bond confines corrosion. (N.W.R.)

9176 FORGING BERYLLIUM POWDER. M. E. Cieslicki (Wyman Gordon Co., Worcester, Mass.). J. Metals, 14: 149-53(Feb. 1962).

The developments and results obtained in press forging

beryllium powder are described. The forging method consists of using pressures in the range of 20,000 to 100,000 psi, sintering times from 1 sec to 1 min, and two temperature ranges of 1600 and 1900°F. The description of a non-beryllium (stainless steel) can fabricated for holding the beryllium powder is also presented. Properties of forged beryllium are presented and discussed. The process has proved to be more economical than other methods of compaction. (N.W.R.)

9177 WELDING FUEL ELEMENT END CAPS. A. Mombrun (United Power Co., Ltd., Heston, Eng.), D. F. Adams, and R. L. Apps. Nuclear Eng., 7: 67-8 (Feb. 1962).

A welding machine is described that employs the argon shielded a-c tungsten-arc process. The machine has so far met all the demands made upon it and although the work to date has been confined to magnesium alloys, the machine is ideally suited to welding tubular fuel can assemblies for advanced reactors or other tubular components of a similar nature. In addition, the machine can be used to obtain information about the limits of accuracy necessary for producing any specific joint design and could thus supply basic design data for single purpose production welding machines. The machine has a capacity of 48 in. long, 4 in. diameter specimens. The welding speed is 1 to 60 in./min. The operation and adjustable automatic control system of the machine are described. (N.W.R.)

9178 PROTECTIVE EFFECT OF MERCAZOLE (1-METHYL-2-MERCAPTOIMIDAZOLE) AGAINST SINGLE WHOLE-BODY IRRADIATIONS IN MICE. Junichiro Hayakawa, Takehiko Tsuchiya, and Tsutomu Sugahara (National Inst. of Radiological Sciences, Chiba, Japan). Strahlentherapie, 116: 415-19(Nov. 1961). (In English)

The protective effects of mercazole as an antithyroidal agent were studied in two inbred strains of mice different in radiosensitivity and thyroid activity, i.e., RF and C 57 BL. Mercazole administered per os for a week before whole-body irradiation of the near lethal dose increased the thirty days survival significantly in the RF mice and not in the C 57 BL. Possible causes of the difference were discussed. It was emphasized that the effect of radioprotective agents might be different according to the strain of animals used. (auth)

9179 EUTECTIC BRAZING OF ZIRCALOY 2 TO TYPE 304 STAINLESS STEEL. W. A. Owczarski (General Electric Co., Schenectady, N. Y.). Welding J. (N. Y.), 41: 78-s-83-s(Feb. 1962).

Zircaloy 2 was joined to AISI 304 stainless steel by a technique called eutectic brazing. No braze filler metal is added to the joint during this process. Instead, a liquid phase is formed by a diffusion controlled eutectic reaction between the two base metals. The liquid eutectic forms at about 980°C, a temperature far below the melting temperature of either base metal. The resultant alloy formed on resolidification has fair strength but low ductility. It does possess good corrosion resistance in hot pressurized water. Several applications are described in which eutectic brazing is used to provide pressure seals and transition joints which have performed well in service. Some evaluation of the joints is presented as well as a general description of the mechanism of the process. (auth)

9180 MANUFACTURE OF BERYLLIUM TUBES. Joseph Clifford Guest and William Arthur Sallis (to T. I. (Group Services) Ltd.). British Patent 884,410. Dec. 13, 1961.

A method is outlined for producing beryllium tubes. The method comprises producing a hollow beryllium billet by casting or hot pressing, placing an extensible metal core in the bore of the billet and the billet in an extensible metal envelope, heating the assembly to 900 to 1100°C, extruding the assembly through a die, and subsequently removing the core and envelope. (D.L.C.)

9181 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF SHEATHED FORMED ELEMENTS. Maurice Gauthron and Claude Beernaert (to Commissariat à l'Energie Atomique). British Patent 887,797. Jan. 24, 1962.

A method and an apparatus are described for producing sheathed reactor fuel elements. In this method, an element is formed and located within a container, and the container is evacuated and heated simultaneously or prior to reduction of its dimensions by passing through a die. (D.L.C.)

9182 METHOD OF JOINING CARBIDES TO BASE METALS. Nerses H. Krikorian, John D. Farr, and Willard G. Witteman (to U. S. Atomic Energy Commission). U. S. Patent 3,020,632. Feb. 13, 1962.

A method is described for joining a refractory metal carbide such as UC or ZrC to a refractory metal base such as Ta or Nb. The method comprises carburizing the surface of the metal base and then sintering the base and carbide at temperatures of about 2000°C in a non-oxidizing atmosphere, the base and carbide being held in contact during the sintering step. To reduce the sintering temperature and time, a sintering aid such as iron, nickel, or cobalt is added to the carbide, not to exceed 5 wt %. (AEC)

Properties and Structure

9183 (AAEC/E-80) A COMPARATIVE STUDY OF TWO GRADES OF BeO. K. D. Reeve and E. J. Ramm (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Nov. 1961. 33p.

Pechiney and Brush UOX BeO differ markedly in fabrication behavior, only Brush UOX being readily sinterable. A comparative study of the two powders has shown few outstanding differences in powder properties. Both are of high purity but contain free and combined moisture to the extent of about 1.5%. Pechiney BeO has a larger mean crystallite size (0.2 to 0.3μ) than Brush UOX (0.1 to 0.15μ) and a larger range of crystallite size, and both contain a small proportion of crystallites of size 1μ and larger. The tap density of UOX is much lower than that of Pechiney, and its surface area is higher by a factor of two. UOX BeO can be hot-pressed or cold-pressed and sintered to high densities at 1400 and 1500°C, respectively, which are approximately 300°C lower than those required for Pechiney. Grain size of fabricated material increases with fabrication temperature in both grades, and at the same temperatures is larger for UOX than Pechiney. However, at comparable densities grain sizes are also comparable for the two materials. The bend strength at room temperature of hot-pressed Pechiney BeO reaches a maximum of approximately 30,000 psi when pressed at 1750°C. Above this temperature the strength falls because of increasing crystallite size. Cold-pressed and sintered Brush UOX appears weaker, possibly from weaker grain boundary cohesion. Cold-pressed and sintered BeO is considered worthy of most intensive study as an irradiation resistant material, and suggestions are given for improving its strength and homogeneity and decreasing its crystallite size. (auth)

9184 (AD-260194) THE ELECTRICAL BEHAVIOR OF REFRACTORY OXIDES. Bimonthly Progress Report (203-3). Robert W. Vest (Systems Research Labs., Inc., Dayton, Ohio). July 12, 1961. Contract AF 33(616)-7748. 18p.

Polycrystalline and single-crystal samples of ZrO_2 were prepared. The electric conductivity of a polycrystalline ZrO_2 sample was measured at 200 to 1360°C. Polarization measurements were also made on ZrO_2 at 907°C. (D.L.C.)

9185 (AD-261209) THE MAGNETIC PROPERTIES OF THE HEUSLER ALLOYS. Annual Technical Status Report No. 1 [for period] July 1, 1960–July 1, 1961. (Sheffield, England. Univ.). Contract DA/91/591/EUC-1497. 35p.

A systematic survey of the intrinsic magnetization of the Heusler alloys was commenced. A Sucksmith ring balance suitable for measurements of magnetizations of the order of those of the Heusler alloys was constructed. Cu_2MnSb. The lattice parameter of the alloy prepared was found to be 6.096 ± 0.003 Å. Ferromagnetic properties were not evident even at temperatures as low as 70°K. Cu_2MnIn. Preliminary magnetic measurements on an ordered sample of this alloy showed good agreement with previous workers. Cu_2MnSn. The low temperature magnetic measurements indicate a Bohr magneton number of 4.2/Mn atom. The degree of order of the alloy is found to be sensitive to the quenching temperature. Cu_2MnGe. Samples quenched from 800 and 825°C are found to exhibit the maximum magnetizations corresponding to a Bohr magneton number of approximately 3/Mn atom. Powder photographs reveal inhomogeneity in the alloy even after 100 hrs homogenization at 800°C. The structure is tentatively identified as tetragonal with a = 4.90 Å, c = 4.68 Å, c/a = 0.96, with the presence of small amounts of alien phases. Cu_2MnY. An attempt to prepare a Heusler alloy containing yttrium was unsuccessful; a polyphase non-ferromagnetic alloy resulted. $Cu_2MnIn_{.5}Sb_{.5}$. An alloy of the above composition was prepared and found to be ferromagnetic after slow cooling. The structure was of the Heusler type and the lattice parameter found to be 7.047 ± 0.001 Å. (D.L.C.)

9186 (AEEW-R-41) MEASUREMENT OF THE SURFACE TENSION OF SANTOWAX 'R', PARA-, META-, AND ORTHO-TERPHENYL, DIPHENYL, DIPHENYL ETHER AND DOWTHERM 'A.' R. W. Bowring, D. A. Garton, and J. H. Kinneir (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Sept. 1961. 36p.

Values of surface tension were obtained over the temperature range from near the melting point to near the normal boiling point of each substance. A capillary rise method was used employing a closed glass U-tube apparatus. The accuracy was ±3% near the melting point falling to ±5% near the normal boiling point. Values of the parachor calculated from the experimental data were in excellent agreement with those calculated from the molecular structure using the method proposed by Sugden. The surface tension in each case decreased with ascending temperature from near 30 to 40 dynes/cm close to the melting point to 13 to 15 dynes/cm near the normal boiling point. (auth)

9187 (AFCRL-850) MATERIALS FOR THERMOELECTRIC GENERATORS. Final Report. E. Miller, F. Ermanis, and I. Cadoff (New York Univ., New York. Coll. of Engineering). July 1961. Contract AF19(604)-3902. 30p. (AD-264375)

The solidification and electronic characteristics of CdSb, ZnSb, and alloys of the system $Zn_xCd_{(1-x)}Sb$ were studied for application to thermoelectric devices. Complex phase relations limited the study of ZnSb which could not readily be prepared in single phase form. CdSb single crystals were prepared and pertinent electronic data were obtained. Infrared absorption in the <100> direction of single crystal samples of CdSb gave a value for the energy gap at room temperature for indirect transitions of 0.45 ev with a temperature variation of -6×10^{-4} ev/°K. From resistivity, Hall coefficient, and Seebeck coefficient data, the energy gap at 0°K was calculated to be 0.57 ev the mobility ratio 0.9, and the hole effective mass was found to increase with temperature from 0.2 to 0.38 between 100°K and 300°K. The conductivity was found to be anisotropic, the three principal conductivities being the ratio $\sigma_{010} : \sigma_{100} : \sigma_{001} = 1.45 : 1.09 : 1.00$. The phase relations between ZnSb and CdSb also showed metastable-stable reactions. In the metastable system the section $Zn_xCd_{(1-x)}Sb$ showed a eutectic at about $Zn_{0.1}Cd_{0.9}Sb$. No eutectic was observed in the stable but complete miscibility of ZnSb and CdSb was not definitely observed. (auth)

9188 (AROD-2891.1) THE YOUNG'S MODULUS AND INTERNAL FRICTION OF POLYCRYSTALLINE MgO AT ROOM TEMPERATURE. First Year Report, September 1, 1960 to September 1, 1961. Rinoud Hanna and W. B. Crandall (New York. State Univ. Coll. of Ceramics, Alfred). Contract DA-ORD-31-124-60-G58. 40p.

Hot pressing was used to prepare polycrystalline MgO from several starting powders, which behaved distinctly from each other. A direct relationship between the activity of the powder and its "compressibility" was found. As the density of the specimen increased the Young's modulus increased linearly, whereas the internal friction decreased. It was found that the internal friction was inversely proportional to the square of the grain diameter. MgO specimens of the same density, but from different origin may not necessarily have the same Young's modulus or internal friction values; these differences may be attributed to the presence of foreign atoms. (auth)

9189 (ASD-TR-61-66(Pt.II)) DEVELOPMENT AND EVALUATION OF HIGH TEMPERATURE PROTECTIVE COATINGS FOR COLUMBIUM ALLOYS. PART II. COATING EVALUATION. R. A. Jefferys and J. D. Gadd (Tapco, Div. of Thompson Ramo Wooldridge Inc., Cleveland). July 1961. Contract AF33(616)-7215. 103p.

An evaluation was made of 18 coating-base metal systems, viz. six different coatings applied to 3 Nb-base materials (D-31 alloy, F-48 alloy and unalloyed Nb). The 18 systems were tested under identical conditions in cyclic oxidation (2390 and 2500°F), thermal shock (2500 to 250°F), bend-oxidation (2500°F), and stress-oxidation (2500°F), plus tensile tests. The tests produced data for the 18 systems relating to the comparative protective nature of each coating, and to the effect of the coating and the coating treatment on the mechanical properties of the substrate. (auth)

9190 (BMI-1549(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING OCTOBER 1961. Russell W. Dayton and Clyde R. Tipton, Jr. (Battelle Memorial Inst., Columbus, Ohio). Nov. 1, 1961. Contract W-7405-eng-92. 92p.

Progress is reported on reactor materials and components, studies of fuels, general fuel-element development, growth of UO_2 single crystals, radioisotope and radiation applications, materials development and evaluation, coated-particle fuel materials, corrosion studies of the Fluoride Volatility Process, assistance of the CANDU reactor program, radiation-effects study of candidate fuel materials for the MGCR, radiation studies of SM-2 fuels, and the gas-cooled reactor program. (M.C.G.)

9191 (DC-58-11-103) MATERIALS, FABRICATION AND PROPERTIES OF Ni–Cr FUEL RIBBON. G. T. Muehlenkamp (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 14, 1958. Contract AT(11-1)-171. 35p.

Descriptions and specifications concerning materials of construction, methods of fabrication, and the properties of Nb modified 80 Ni–20 Cr fuel ribbon containing UO_2 as finely dispersed particles are presented. The assembly of fuel-element cartridges and their performance under irradiation at high temperatures are discussed. (auth)

9192 (DC-59-4-27) STRESSES IN HOLLOW HEXAGONS SUBJECTED TO EXTERNAL PRESSURE. W. E. Nickola (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 26, 1959. Contract AT(11-1)-171. 43p.

Results of investigations are presented concerning stresses produced in hollow hexagonal sections subjected to external pressure. It was found that stresses in such sections are all compressive if pressure on all external faces is uniform. Of the conditions tested, a uniform pressure load on two opposite external faces produces the highest stress per unit of applied pressure. An approximation is included for the relationship between maximum tensile stress and the ratio of hole diameter to width across flats. (J.R.D.)

9193 (DMIC-Memo-141) THE EMITTANCE OF CHROMIUM, COLUMBIUM, MOLYBDENUM, TANTALUM, AND TUNGSTEN. W. D. Wood, H. W. Deem, and C. F. Lucks (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Dec. 10, 1961. 48p.

A compilation is presented of the emittance, reflectance, and absorbance of Cr, Nb, Ta, W, Nb–10% Mo–10% Ti, and Mo–0.5% Ti, as functions of temperature and wavelength. Both total and spectral values for these properties are given, and the effects of surface conditions are taken into account. A bibliography consisting of 24 references is included. (T.F.H.)

9194 (FXM-4986) PHYSICAL AND THERMODYNAMIC PROPERTIES OF LITHIUM. N. T. Crane (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Jan. 19, 1961. Contract [AT(11-1)-229]. 18p.

A literature survey was conducted on the physical and thermodynamic properties of lithium. Graphs are presented for the following properties: density, vapor pressure, viscosity, surface tension, electrical resistivity, thermal conductivity, heat capacity, enthalpy, enthalpy function, free energy, free energy function, and entropy. (D.L.C.)

9195 (GEMP-7A) HIGH-TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT NO. 7, PART A. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Jan. 15, 1962. Contract AT(40-1)-2847. 63p.

Progress is reported on the development of metallic fuel element materials for greater than 1200°C operation in oxidizing atmospheres, high-temperature control materials, and high-temperature thermal insulation. The effects of radiation on high-temperature alloys were studied. Moderators were fabricated and tested. (M.C.G.)

9196 (GEMP-103A) SUMMARY OF HIGH TEMPERATURE MATERIALS WORK PERFORMED IN FY 61, PART A, MAY 1, 1961–JUNE 30, 1961. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Dec. 1961. Contract AT(40-1)-2847. 20p.

Testing of Nb–Al–Ti alloy rods at 590 to 1370°C for 500 hr (cycling to room temperature after each 100 hr) indicates that Nb–Al–Ti alloys require a fourth element such as Cr to prevent spalling of oxides at 1040 to 1260°C. Progress is summarized for fabrication of FeCrY–Eu_2O_3 cermets and for radiation effects on high-temperature alloys. Steps involved in the preparation and cladding of hydrided Y–5 wt % Cr alloy cores are described. The irradiation program to be conducted on BeO is outlined. (D.L.C.)

9197 (HW-63137) RUPTURE KINETICS OF ZIRCALOY-CLAD FUEL ELEMENTS IN HIGH TEMPERATURE WATER AND STEAM. Interim Report No. 6. Effects of Carbon and Zirconium Content on Uranium Corrosion and Rupture Mechanisms. V. H. Troutner (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 30, 1959. Contract AT(45-1)-1350. 24p.

Reduction of the carbon content to very low values (about 30 ppm) eliminated non-uniform hydride attack of bare uranium at 200°C. The addition of 1 to 2% zirconium reduced the uniform corrosion rate of uranium by a factor of 5 to 7, and eliminated the non-uniform hydride attack. An optimum concentration appeared to be between 1.0 and 1.6%. Rupture curves were obtained with pinhole-defected rod elements made from uranium with low carbon content, and uranium with zirconium added. In contrast to the behavior of the bare corrosion samples, the reduction in carbon content did not eliminate the non-uniform hydride attack at 200°C. The addition of zirconium reduced the rupture rates markedly. Mechanisms are presented for various types of fuel element ruptures. The effects of heat treatment and water flow are discussed in view of these mechanisms. (auth)

9198 (HW-64573) OBSERVATIONS ON A ZIRCALOY–URANIUM–ALUMINUM SYSTEM AT HIGH TEMPERATURES. A. J. Scott (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 27, 1960. Contract AT(45-1)-1350. 18p.

Three small-scale tests were made to study the reactions of the uranium–aluminum–Zircaloy system at temperatures of 1182 to 1580°C. Of particular interest was whether the Zircaloy would contain the molten uranium and aluminum. Test components were present in scaled down amounts approximately proportionate to a 4-inch solid fuel element and process tube. Following observation of the heating procedure, the residue from each test was examined metallographically. For heating times of 5 and 26 minutes at 1580 and 1540°C respectively, the Zircaloy was destroyed in the area of contact with the clad molten uranium. At 1182°C for 24 minutes, no reaction with the Zircaloy took place. A 150-gram section of the remaining uranium diffusion alloy from the 1540°C test was heated rapidly in air to 1460°C to observe any possible pyrophoric behavior. No unusual reactions were observed and the sample cooled rapidly when heating was discontinued. These tests suggest that an aluminum–uranium alloy is formed at the interface of the clad element and Zircaloy tube and effectively prevents the Zircaloy from diffusing into the uranium if the melting point of the uranium–aluminum alloy is not exceeded. (auth)

9199 (HW-67641) CORRELATION OF ZIRCALOY-2 CREEP DATA WITH A TIME-TEMPERATURE PARAMETER. J. J. Holmes (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 9, 1961. Contract [AT(45-1)-1350]. 6p.

The application of a time-temperature parameter in the extrapolation and correlation of Zircaloy-2 creep and

rupture data is demonstrated. This time-temperature parameter θ has the property of path independence under constant stress which allows the prediction of long-time, steady and cyclic temperature, service behavior from relatively short time tests. (M.C.G.)

9200 (HW-71887) A NOTE ON THE STRUCTURAL STABILITY OF PLUTONIUM DIOXIDE. T. D. Chikalla (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 30, 1961. Contract [AT(45-1)-1350]. 20p.

Roberts calculations on the thermodynamics of PuO_2 reduction were extended. A table of oxygen pressures for various atmospheres is presented. Oxygen partial pressures, the reduction of PuO_2 in hydrogen, and vacuum reduction are discussed. Data are given on the crystallographic stability of PuO_2. (M.C.G.)

9201 (MAB-175-M(Vol.I)) SYMPOSIUM ON DESIGN WITH MATERIALS THAT EXHIBIT BRITTLE BEHAVIOR, DECEMBER 13-14, 1960, WASHINGTON, D. C. (National Research Council. Materials Advisory Board). Oct. 20, 1961. 426p. Contract DA-36-039-sc-76436.

An assessment was made of the state of the art in designing efficient and reliable load-carrying structures with materials which exhibit brittle behavior. Topics covered in the 19 papers presented include brittle material behavior, lifting re-entry vehicle design with brittle material, propulsion system and radome design with brittle materials, and brittle material design. (M.C.G.)

9202 (MND-2584-2) RADIOISOTOPE SEMICONDUCTOR AND THERMOELEMENT RESEARCH AND DEVELOPMENT. Quarterly Progress Report No. 2, June 1 to August 31, 1961. J. B. Weddell (Martin Co. Nuclear Div., Baltimore). Sept. 28, 1961. Contract AT (30-1)-2698. 40p.

Specimens of strontium titanate containing additions of iron, zirconium hydride, and yttrium oxide have been prepared by sintering the hydrogen at 1450°C. Gradients of strontium-90 concentration have been produced in strontium titanate by ion exchange techniques. Specimens of cerium titanate have also been prepared. Some of the constants appearing in the thermodynamic heat and charge transport equations have been evaluated. The Seebeck coefficient, electrical resistivity, thermal conductivity, Hall coefficient, and activation energy of some of the nonradioactive strontium titanate materials have been measured. The thermoelectric properties have been measured at 30 to 1110°C. Material composed of 78 wt % strontium titanate, 20 wt % iron, 1.8 wt % zirconium hydride and 0.2 wt % yttrium oxide has a maximum figure of merit of $1.0 \times 10^{-4}°C^{-1}$ at 600°C. A thermoelement optimization code for the IBM 7090 computer has been modified to permit consideration of cold junction resistance and of heat sources within the thermoelements. (auth)

9203 (NP-11234) RESEARCH ON PHASE EQUILIBRIA BETWEEN BORON OXIDES AND REFRACTORY OXIDES, INCLUDING SILICON AND ALUMINUM OXIDES. Quarterly Progress Report No. 3, January 1, 1960 – March 31, 1960. P. J. Gielisse, T. J. Rockett, T. S. Shevlin, and W. R. Foster (Ohio State Univ. Research Foundation, Columbus). Apr. 25, 1960. Contract AF33 (616)-6509. 23p.

A method is described for preparing the compound $2Al_2O_3 \cdot B_2O_3$. A study was made on the volatilization of amorphous and crystalline B_2O_3. Plans for work on the $SiO_2 - B_2O_3$ system are described. Hypothetical phase diagrams are presented for the $B_2O_3 - Al_2O_3$ system, and some preliminary results are discussed. (D.L.C.)

9204 (NP-11235) RESEARCH ON PHASE EQUILIBRIA BETWEEN BORON OXIDES AND REFRACTORY OXIDES, INCLUDING SILICON AND ALUMINUM OXIDES. Quarterly Progress Report No. 5, October 1, 1960 – December 31, 1960. P. J. Gielisse, T. J. Rockett, and W. R. Foster (Ohio State Univ. Research Foundation, Columbus). Jan. 9, 1961. Contract AF33(616)-6509. 22p.

The liquidus part of the phase diagram of the $B_2O_3 - SiO_2$ system was determined, and the growth crystals were identified. Experimental data on the stability of the compounds $9Al_2O_3 \cdot 2B_2O_3$ and $2Al_2O_3 \cdot B_2O_3$ are discussed. Selected firings were made in the $Al_2O_3 - B_2O_3 - SiO_2$ system to indicate possible compatibility patterns, and a hypothetical ternary phase diagram is presented for this system. (D.L.C.)

9205 (NP-11287) DEVELOPMENT OF TANTALUM–TUNGSTEN ALLOYS FOR HIGH PERFORMANCE PROPULSION SYSTEM COMPONENTS. Quarterly Report No. 8, January 10, 1961 to April 9, 1961. M. L. Torti (National Research Corp., Cambridge, Mass.). Contract NOrd-18787. 10p.

Carburization experiments were carried out on Ta and Ta–10% W MEREM nozzles at 2300 and 2500°C. Nozzle firings were carried out at a flame temperature of 6240°F; the carburized pure Ta inserts failed, but the carburized Ta–10% W firings were successful. A test firing of a Ta–10% Hf–5% W insert is reported. (D.L.C.)

9206 (NP-11340) AN INVESTIGATION OF URANIUM-BEARING CR–MO–V STEELS FOR ELEVATED TEMPERATURE SERVICE. PART I. PROJECT F-37, THE EFFECT OF URANIUM ON STEAM TURBINE STEELS 0.25% C, 1% Cr, 1% Mo, 1% V. Internal Report PM-R-61-6. Charles E. Makepeace (Eldorado Mining and Refining Ltd., Ottawa and Canada. Dept. of Mines and Technical Surveys. Mines Branch). May 8, 1961. 122p.

An investigation was made of the behavior of uranium-bearing steel containing Cr, Mo, V, Ti, Mn, and 0.25% C, as evidenced by a statistical examination of the effect of heat treatment and by plotting hardness-temperature curves. Metallographic examination revealed the presence of two additional phases believed to be UC and the epsilon phase, UFe_2. The addition of uranium in quantities necessary to form massive and difficultly soluble carbides decreases the secondary hardening effect at lower austenitizing temperatures due to formation of these massive carbides and some UFe_2. The presence of strong carbide formers like titanium, in the presence of less than 0.30% U, has the effect of decreasing hardness due to formation of titanium carbides and massive uranium carbides. Uranium in excess of 1.00% in the absence of titanium also has the effect of a general decrease in hardness at austenitizing temperatures 1850 to 1950°F and tempering temperatures 800 to 1200°F due to formation of massive uranium carbides (and the epsilon phase, UFe_2) which have not dissolved during these solution heat treatment cycles. Uranium residuals less than 0.2% in the absence of titanium result in an increase in hardness, and in some cases, in the position of the peak hardness after solution treatment, water-quenching, and tempering. The resistance to corrosion in an acid environment, 14% HCl at 120°F (50°C), was improved by use of 0.10 and 2.00% uranium. The macrostructure of steels containing 0.10 to 1% uranium is improved. Additions of 0.10% uranium improves the stress rupture properties of specimens stressed to 24,600 psi at 984°F. Although surface oxidation at 1058°F is not increased by uranium additions up to 0.10%, higher uranium residuals (2.11%) double the loss due to oxidation at this temperature. (auth)

9207 (NP-11348) INVESTIGATION OF DIFFUSION BARRIERS FOR REFRACTORY METALS. Progress Report No. 9, October 15, 1961–January 15, 1962. (Manufacturing Labs., Inc., Cambridge, Mass.). Jan. 18, 1962. Contract AF33(616)-6354. 25p.

Evaluation of the Mo–Rh, Mo–W, and W–Rh combinations for interdiffusion at 1700°C was completed. The W–Re, W–Ru, W–Ir, W–Rh, and Ta–Ir base-barrier combinations as well as the Re–Rh and Ir–Rh barrier-coating combinations were evaluated for interdiffusion at 1800°C. Interdiffusion experiments at both temperatures indicated that the relative extent of interdiffusion in the promising combinations increases in the following orders: W–Os, W–Re, W–Ir, W–Ru, and W–Rh for W–base combinations; and Ta–Re, Ta–Os, Ta–Ru, and Ta–Ir for Ta–base combinations. The relative extent of interdiffusion appears to increase approximately with decreasing barrier melting point. The combinations selected as optimum now consist of the following: W–Re, W–Ru, W–Ir, Mo–W, Mo–Re, Mo–V, Ta–W, Ta–Re, Ta–Os, Ta–Ru, Cb–W, Cb–Re, Cb–Os, and Cb–Zr. Investigations of intermediate phase growth kinetics were started for W–Re. (auth)

9208 (NYO-10009) ULTRASONIC IMPREGNATION: PREPARATION OF LOW PERMEABILITY GRAPHITE. William B. Tarpley and Herbert Kartluke (Aeroprojects, Inc., West Chester, Penna.). Dec. 1961. Contract AT(30-1)-1836. 16p.

Ultrasonic impregnation of graphite with furfuryl alcohol resin was briefly investigated. More effective impregnation per cycle was observed and lower permeability was measured for a total of five impregnation-carbonization cycles. Control specimens of ATJ-82 were reduced to only 33% of their original permeability compared to 0.36–0.92% for the ultrasonic specimens. A newly developed commercial grade of graphite appeared to have a permeability about one-thousand times that of the ultrasonically impregnated specimens. Further lowering of permeability appeared possible through additional ultrasonic impregnation. (auth)

9209 (ORNL-TM-135) TRANSPORT OF NOBLE GASES IN GRAPHITES. Progress Report for the Period January 31, 1961 to January 31, 1962. J. Truitt, N. V. Smith, G. M. Watson, R. B. Evans, III, and E. A. Mason (Oak Ridge National Lab., Tenn.). Feb. 7, 1962. Contract [W-7405-eng-26]. 32p.

A model was derived for the diffusion of gases in porous media in the absence of temperature and pressure gradients, in which portions of the medium are visualized as a collection of uniformly distributed "dust" particles (giant molecules) which are constrained to be stationary. Thus, it was possible to derive all the desired results from rigorous diffusion equations for multi-component mixtures. The results apply over the entire pressure range from the Knudsen region to the normal diffusion region. This model permits a satisfactory derivation of the fact that, at all pressures, the flux ratio of two counter-diffusion gases is $(m_2/m_1)^{1/2}$ in porous media under steady state and uniform-pressure conditions. The effect of non-zero pressure gradients on the diffusion equations is to introduce into the fundamental kinetic theory equations both a pressure diffusion term and an external force term. There is a considerable cancellation of terms, and the final diffusion equation has the same form as in the uniform pressure case. No additional parameters beyond those necessary to define a diffusing system at uniform pressure are thus required to compute the diffusion rates when pressure gradients are present. A complete solution requires also a forced flow equation giving J (the net flux) as a function of the pressure gradient. A forced flow equation is derived on the basis of the dusty-gas model, but one parameter must be made disposable in order to compensate for the fact that the model permits only a diffusive mechanism for flow, never a viscous mechanism. A series of experiments wit.. helium and argon in graphite is discussed as well as the possibility of extending the model to include the effects of temperature gradients. (auth)

9210 (TID-3096) PLUTONIUM. Bibliography of Selected Report Literature. Richard J. Smith, comp. (Office of Technical Information Extension, AEC). July 1961.

A total of 761 annotated references to unclassified reports and the published literature is presented on the subject of plutonium technology. References are not included concerning reactor fuel reprocessing and details of specific reactors; otherwise the scope is not limited. Author, subject, and report number indexes are provided. (auth)

9211 (TID-14561) THE THERMAL CONDUCTIVITY OF INORGANIC MELTS. Annual Report and Proposal for Renewal of Contract AT(30-1)-2360 for a period of 12 months beginning March 15, 1962. (Carnegie Inst. of Tech., Pittsburgh. Metals Research Lab.). Dec. 15, 1961. 24p.

Following an unsuccessful attempt to determine the thermal conductivity of cuprous chloride and the reconstruction of the apparatus, it was decided to work on molten silver sulfide. The thermal conductivity of silver sulfide was measured from 720 to 972°C for two compositions, one approximately stoichiometric Ag_2S and the other slightly richer in Ag. The thermal conductivity of molten silver sulfide near the stoichiometric ratio for Ag_2S was low and of the same order of magnitude as reported for lower-melting ionic salts. It appeared that the electronic contribution is very small and that phonon conduction is the dominant mechanism. (M.C.G.)

9212 (TID-14566) HIGH TEMPERATURE STABILITY RELATIONS AMONG COBALT OXIDES, AND THEIR ACTIVITIES ON SOLID SOLUTION CRYSTALS. Progress Report, May 1–December 15, 1961. Arnulf Muan and Egil Aukrust (Pennsylvania State Univ., University Park. Coll. of Mineral Industries). Dec. 15, 1961. Contract AT(30-1)-2781. 32p.

Work on fundamental equilibria involving cobalt oxides is summarized. The stability ranges as a function of temperature and oxygen pressure of Co, CoO, and Co_3O_4, and the non-stoichiometry as a function of oxygen pressure in the oxides CoO and Co_3O_4 were determined. Two independent methods were used to determine activity-composition curves for the three solid solution series CoO–MgO, CoO–MnO, and CoO–FeO. Phase relations were determined for the four systems formed when cobalt oxide is combined with Al_2O_3, Cr_2O_3, iron oxides, and manganese oxides. A feature of all systems except with the manganese oxides was the coexistence of two separate spinel phases in equilibrium. Preliminary investigations were carried out in order to determine which silicate systems are best suited for experimental study of thermodynamic properties. (M.C.G.)

9213 (TID-14690) STATISTICAL THERMODYNAMICS OF METALLIC SOLUTIONS. Annual Progress Report, January 31, 1961 to January 31, 1962. L. P. Skolnick (Delaware. Univ., Newark). Dec. 28, 1961. Contract AT(30-1)-2722. 36p.

Progress is reported on investigations of the theory of metallic solutions using the Morse potential in a conformed model, and the computer analysis of thermodynamic data

for ternary solutions of cadmium–lead alloys containing additions of antimony, bismuth, and tin. Developments are discussed in the design of equipment and the preparations made in the studies of work functions of metallic solutions, NMR measurements, thermodynamic properties of copper–gold–silver alloys, and Debye temperatures of alloys. (B.O.G.)

9214 (TID-14810) PROGRESS REPORT. PART 1. RESIDUAL STRESS AFTER PLASTIC ELONGATION AND MAGNETIC LOSSES IN SILICON STEEL. B. D. Cullity. PART 2. MAGNETOSTRICTION AND RESIDUAL STRESS IN NICKEL AFTER PLASTIC ELONGATION. B. D. Cullity and O. P. Puri (University of Notre Dame, Notre Dame, Ind.). Jan. 1962. Contract AT(11-1)-713. 49p.

Existing x-ray data on residual lattice strains in silicon steel after plastic elongation are summarized. A particular residual microstress distribution is postulated, which accounts for both the x-ray observations and certain magnetic measurements. The stresses are assumed to be distributed so that the bulk of the material is in compression in the direction of previous tension, and a very small portion is in tension. The former part is tentatively identified with the sub-grains revealed by the electron microscope, and the latter with the dislocation walls which form the subgrain boundaries. The possibility that stacking faults may interfere with x-ray stress measurements is examined. The magnetostriction of nickel after increasing amounts of plastic elongation was measured at field strengths up to 1500 oersteds. In addition, the residual stress was measured by means of x-ray line shifts. The observed decrease in magnetostriction following plastic strain is shown to be associated with residual compressive stress. (auth)

9215 (TID-14878) SOLUBILITY OF URANIUM IN LIQUID BISMUTH. Final Report, February 4, 1958–December 31, 1958. A. F. Weinberg and Ray J. Van Thyne (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 26, 1959. For Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va. Subcontract AT(30-1)-1940-7. 76p.

The design of the Liquid Metal Fuel Reactor Experiment requires quantitative data on the solubility of U in molten Bi and in Bi plus other additives. In the prosecution of this investigation, the independent experimental techniques employed were chemical analysis of samples obtained by filtration from saturated melts and determination of the variation of electrical resistance with temperature. As an adjunct to this investigation an improved spectrochemical analytical technique was developed. U solubility in molten Bi was determined at 350 to 600°C, varying from 0.09 wt.% (900 ppm) to near 2 wt.%, respectively. The effect of Zr, Mg, simulated fission products, and Na on U solubility in Bi were also determined at 370 to 420°C. Zr severely decreased U solubility; Mg added to the ternary system Bi–U–Zr has little effect below 375 to 390°C (dependent upon Mg concentration) but causes the U solubility to rapidly increase above that temperature, equalling that in the binary system Bi–U near 405°C. The other additives have only slight effects on U solubility when added to the system Bi–U–Zr–Mg. Information is included on metal fiber filters, design of electrode for spectrochemical analyses, and chemical analytical procedures. (auth)

9216 (XDCL-60-7-718) ETR GEEL 99 IN-PILE TUBE STRESS ANALYSIS FOR INCONEL "X". R. E. Cook (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 12, 1960. Contract AT(11-1)-171. 32p.

An analysis is presented of the pressure, thermal and combined stresses developed in a GEEL 99 in-pile tube with an Inconel X pressure tube when the tube is installed in the Engineering Test Reactor. (auth)

9217 (AEC-tr-4997) PREPARATION AND PROPERTIES OF YTTRIUM MONOCARBIDE. G. V. Samsonov, G. N. Makarenko, and T. Ya. Kosolapova. Translated by Martha Gerrard (Oak Ridge National Lab., Tenn.) from Zhur. Priklad, Khim., 34: 1444-8(July 1961). 5p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 27985.

9218 (AEC-tr-4999) SIMPLE ELECTROLYTIC METHOD OF PREPARING THIN METALLIC FOILS FOR DIRECT EXAMINATION BY ELECTRON MICROSCOPY. N. Azam, M. Bouleau, and P. A. Jacquet. Translated by Myra Scott Feldman (Savannah River Lab., Aiken, S. C.) from Compt. rend., 252: 698-700(Jan. 30, 1961). 6p.

Samples of numerous metals and alloys, including U and Zr, may be decreased in thickness by means of a filiform cathode moved manually before a sample immersed in an electrolyte capable of polishing under small current densities. The process can also be used for prethinning. The process does not require as complicated an apparatus, or as high a current density, as other methods of electrolytic thinning for electron microscope observations. (auth)

9219 (CEA-tr-R-1440) CREUSETS EN CARBURES, BORURES ET NITRURES REFRACTAIRES. (Crucibles of Carbide, Boride and Nitride Refractories). G. V. Samsonov, G. A. Yasinskaya (Iasinskaia), and Shuo-wei T'ai (Tai-Shou-Yei). Translated into French from Ogneupory, 25: No. 1, 35-8(1960). 13p.

By means of successive increases in the temperature and pressure, crucibles are formed from Ti boride, carbide, and nitride; borides of Cr, Zr, W, and Mo; and a Ti boride-5% Mo system. These crucibles are tested by having small samples of Sn, Bi, Pb, Cd, carbon steel, cast iron, and acidic and basic slags melted in them. The resistances of the various crucible materials to each of these test samples are detailed. (T.F.H.)

9220 (FTD-TT-61-127) CALCULATION OF THE THERMODYNAMIC PROPERTIES AND THE CONSTRUCTION OF is-DIAGRAMS FOR ALKALI METALS. E. E. Shpil'rayn and E. I. Asinovskii (Asinovskiy). Translated from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 4: No. 2, 18-26(1961). 16p.

On the basis of the data available on the thermodynamic properties of alkali metals and vapor phases, a method was developed for calculating their thermodynamic functions. An analysis was made of the effect of dimerization in the vapor of alkali metals and a method is shown for taking into account this effect when calculating the enthalpy, entropy, and pressure of saturated vapor. An is-diagram (enthalpy-entropy diagram) is shown for the alkali metals. (auth)

9221 (NP-tr-857) ELASTIC–PLASTIC THERMAL STRESSES IN SPHERICAL GRAPHITE-SHEATHED FUEL ELEMENTS. O. Machnig and P. Handge. Translated by L. F. Secretan (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Kerntechnik, 3: 258-61(June 1961). 16p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 25251.

9222 THE INFLUENCE OF Zr ON STRUCTURAL, MECHANICAL, AND TECHNOLOGICAL CHARACTERISTICS OF THE 7075 ALLOY. C. Panseri and E. Di Russo (Istituto Sperimentale dei Metalli Leggeri, Milan). Alluminio, 30: 549-60(1961). (In Italian)

The introduction of 0.15 to 0.20% zirconium in aluminum alloy type 7075 increases the degree of critical cold working, opposes efficaciously the recrystallization of extruded or forged pieces at elevated heat treating, and increases the mechanical resistance and the fatigue limit of the alloy. Zirconium does not alter the plasticity of the alloy in the hot condition and does not influence the variations of mechanical characteristics which are caused by varying age-hardening conditions. Its antirecrystallizing action consents to reduce the chromium content, which, when superior to 0.2%, can stimulate dangerous segregations of $CrAl_7$. (auth)

9223 AN OXIDATION RESISTANT BORIDE COMPOSITION. Peter T. B. Shaffer (Carborundum Co., Niagara Falls, N. Y.). Am. Ceram. Soc. Bull., 41: 96-9(Feb. 1962).

A modified zirconium diboride composition was developed which not only has good oxidation resistance (four hours in air at 3542°F), but also has good resistance to thermal shock fracture. A densified mixture of zirconium diboride containing 5 to 15 molar % of molybdenum disilicide showed excellent thermal and electrical conductivity and good high temperature strength. The composition may be used either in a dense, massive form or applied as a coating to other materials, providing a high degree of oxidation protection for substrate materials such as refractory foams, which have low density and low thermal conductivity. (auth)

9224 ANALYSIS OF THE STRESS-STRAIN RELATIONSHIPS IN REACTOR GRADE GRAPHITE. G. M. Jenkins (Berkeley Nuclear Labs., Gloucester, Eng.). Brit. J. Appl. Phys., 13: 30-2(Jan. 1962).

Departure from linearity in the stress-strain relationships and plastic deformation are observed in reactor grade graphite at very small stresses. A model is put forward which describes the mechanical behavior of such a material and a simple mathematical theory is derived which is shown to give an adequate description of the stress-strain relationships of graphite on stress cycling under low compressive stresses. (auth)

9225 THE PHASE DIAGRAM OF THE ALUMINUM–BORON SYSTEM. V. T. Serebryanskii, V. A. Epel'baum, and G. S. Zhdanov (Karpov Physico-Chemical Inst., [USSR]). Doklady Akad. Nauk S.S.S.R., 141: 884-6(Dec. 1, 1961). (In Russian)

Aluminum-boron alloys were prepared by heating pressed sample mixtures of Al and B in a helium atmosphere to a high temperature. Thermal changes were followed up to a temperature of 2200°C on heating and cooling. Chemical analyses for aluminum and boron, the density and x-ray analyses were performed on various phases. The 1% boron alloys showed the presence of Al and AlB_2. A peritectic line at 975°C corresponds to the decomposition of AlB_2 to AlB_{12} and Al. With increasing boron content the amount of α-AlB_{12} increases even at temperatures below 975°C. Samples containing 13, 15, 20, and 35% boron were fired at 1500°C. X-ray analysis showed the presence of AlB_2, but the exact nature of the transition at 1450°C could not be established. The compound β-AlB_{12}, "diamond-like boron," is formed via a peritectic reaction at 1550°C. Chemical analyses gave 83% Al and 16.85% B. The compound AlB_{10} was found in samples fired at 1700 to 1750°C, but this compound is converted to α-AlB_{12} on slow cooling. In alloys containing >93% boron, only rhombohedral boron could be detected. Lattice parameters and densities for the various phases are presented. (TTT)

9226 INVESTIGATIONS OF MOLTEN METALS WITH THE AID OF GAMMA-RADIATIONS. A. I. Belyaev (Krasnoyarsk Inst. of Non-Ferrous Metals, [USSR]). Izvest. Vysshikh Ucheb. Zavedenii, Tsvetnaya Met., No. 2, 39-42(1961).

Gamma radiation was employed to investigate some molten metals and binary metallic systems. By measuring the number of pulses per minute (n) the attenuation (absorbtion) of gamma radiations during passage through a layer of molten metal was determined. The following technically pure metals and alloys studied were: Mg, Al, Cu, Zn, Sn, Pb, Al–Zn, Al–Cu, Al–Sn, and Al–Mg. The total content of impurities in the metals did not exceed one tenth of a percent. Results obtained by measuring the pulse number (n) are tabulated. Results of measuring the pulses in the metal systems are given in a series of graphs which show changes in the electron density (de_t) and the density of the alloys (d_t) at liquidus temperatures. It was found that the degree of absorption increased in principle with a higher atomic number (z) and metal density. There is, however, an exception in the case of copper and tin. In spite of the fact that the atomic number of copper (29) is less than that of zinc (30), the number of pulses in the case of molten copper is much lower than that of molten zinc. The same anomaly was observed between zinc and tin. This is apparently due to the fact that the gamma rays encounter, on their way through molten copper, a greater number of electrons than in molten zinc; and in tin a relatively lesser number of electrons than in molten zinc. Therefore the number of pulses for molten metals and salts should be more correctly compared to the volumetric electron density (de). The calculated volumetric electron densities for solid and molten metals are also tabulated. (OTS)

9227 THERMAL CONDUCTIVITY AND EXPANSION OF BERYLLIA AT HIGH TEMPERATURES. R. E. Taylor (Atomics International, Inc., Canoga Park, Calif.). J. Am. Ceram. Soc., 45: 74-8(Feb. 1962).

The thermal conductivities of several specimens of BeO were measured from 350 to 2000°C and were found to follow exactly the 1/T relation to 1700°C, where several competing phenomena occurred. One of these phenomena was associated with grain growth. Another questioned the validity of the 1/T law at temperatures where the mean free path approached interatomic distances. Thermal expansions of hot-pressed and isostatically pressed BeO varying from 50 to 99% density were measured from 20 to 2200°C. Decrepitation occured at 2070°C. (auth)

9228 HIGH-TEMPERATURE DENSITY DETERMINATION OF BORON OXIDE AND BINARY RUBIDIUM AND CESIUM BORATES. Pei-ching Li, Anil C. Ghose, and Gouq-jen Su (Univ. of Rochester, N. Y.). J. Am. Ceram. Soc., 45: 89-91(Feb. 1962).

Density determinations of pure B_2O_3 and binary rubidium and cesium borates were made in the temperature ranges 450 to 1300°C and 500 to 1100°C respectively. The density of B_2O_3 can be represented between 600 and 1000°C as $d = 1.3388 + 228\ (1/T)$ and for temperatures above 1000°C as $d = 1.3947 + 157.9\ (1/T)$, where d is in grams per milliliter and T is in °K. The volume expansion (dV/dT) in the alkali borate systems at 800°C increases with an increase of alkali oxide when the alkali concentration is more than 18 mole %. This increase in the volume expansion follows the order Cs > Rb > K > Na > Li. In the range 15 to 20 mole % alkali oxide a break in the volume expansion was observed. This break suggests a possible change in the structural configuration of the alkali borates. (auth)

9229 THERMOLUMINESCENCE OF ALPHA NIOBIUM PENTOXIDE. E. H. Greener, G. Fehr, and E. E. Angino (Marquette Univ., Milwaukee and Univ. of Kansas, Lawrence). J. Am. Ceram. Soc., 45: 93(Feb. 1962).

Alpha niobium pentoxide (Nb_2O_5) was investigated for thermoluminescence after exposure to ultraviolet or Co^{60} gamma radiation. Unirradiated α-Nb_2O_5 did not exhibit thermoluminescence. After exposure to ultraviolet radiation for 20 hr, peaks were found in the glow curve at 240 and 120°C. After exposures of the order of 5×10^6 r of gamma radiation two peaks were found, but they were not as well defined or as reproducible as those produced by the ultraviolet radiation. The average peak temperatures for two runs were 240 and 110°C. The activation energies for the 243 and 123°C peaks resulting from ultraviolet radiation were 0.7 and 0.4 ev, respectively. The corresponding peaks produced by gamma radiation yielded activation energies of 0.9 and 0.5 ev, which are in good agreement. (P.C.H.)

9230 TENSILE BEHAVIOR OF LITHIUM FLUORIDE. Donald B. Hoover and Jack Washburn (Univ. of California, Berkeley). J. Appl. Phys., 33: 11-14(Jan. 1962).

Tensile stress-strain curves were obtained for single crystals of lithium fluoride. The specimens were elongated at room temperature along a $\langle 100 \rangle$ axis. The number of slip-band sources was controlled by surface treatment. Both the yield stress and the flow stress in the plastic range depend on the number of active slip bands. The shapes of these stress-strain curves were related to the behavior of individual dislocations in lithium fluoride. (auth)

9231 WORK FUNCTION VARIATION OF METALS COATED BY METALLIC FILMS. Elias P. Gyftopoulos and Jules D. Levine (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys., 33: 67-73(Jan. 1962).

A theoretical correlation is derived to account for the variation of the work function of refractory metals coated by metallic films for all degrees of coverage. This correlation is based on an extension of the concept of electronegativity to composite surfaces and use of Pauling's rule about electronegativity and dipole moment of complex molecules. A series of theoretical curves is given for different crystallographically ideal surfaces of refractory metals such as W, Mo, and Ta coated by Cs, Sr, Ba, and Th. The derived correlation is compared with available experimental data for which the experimenters specify the exact conditions under which the experiment is performed and excellent agreement between theory and experiment is established. It is shown for the first time that the maximum work function variation does not necessarily always occur either when a full monolayer is reached or at a definite fractional coverage. The exact position of the maximum variation is a function of the adsorbate and substrate materials and the type of the substrate surfaces. It is also shown that it is erroneous to characterize a monolayer as the point at which maximum emission (or maximum work function variation) is achieved because such a maximum may be flat and extend from half a monolayer to one monolayer. (auth)

9232 A CALCULATION OF THE ELASTIC SHEAR CONSTANTS OF BERYLLIUM. B. T. Bernstein (Union Carbide Research Inst., Tarrytown, N. Y.). J. Appl. Phys., 33: 142-4(Jan. 1962).

Contributions to the elastic shear constants of beryllium at 0°K were calculated using an energy band model. Results are compared with those obtained assuming nearly-free-electron and free-electron behavior for the valence electrons. It was found that the valence electron contribution was very sensitive to the shape of the energy bands and hence the Fermi contribution to the elastic shear constants was strongly dependent upon the energy band model chosen. On the basis of the model, the elastic shear constants of beryllium, like the alkali metals, are predominantly determined by the electrostatic energy of the ion-cores. (auth)

9233 ANISOTROPIC THERMAL EXPANSION OF SINGLE CRYSTALS OF THALLIUM, YTTRIUM, BERYLLIUM, AND ZINC AT LOW TEMPERATURES. R. W. Meyerhoff and J. F. Smith (Ames Lab., Ames, Iowa). J. Appl. Phys., 33: 219-24(Jan. 1962).

The anisotropic thermal expansion of the hexagonal elements, thallium, yttrium, beryllium, and zinc, was measured. The temperature range for the thallium, yttrium, and zinc measurements was 4.2 to 273.2°K, while for beryllium the range was 77 to 273.2°K. Dimensional changes were detected by an interferometric technique, and the movement of the interference fringes by a photomultiplier tube. From the measured values of $\Delta L/L_0$, the coefficients of thermal expansion and the c/a ratios of the metals were calculated as a function of temperature. Previous measurements are reviewed. (auth)

9234 NEUTRON CAPTURE CROSS SECTIONS OF ^{238}U. D. C. Stupegia, R. R. Heinrich, and G. H. McCloud (Argonne National Lab., Ill.). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 15: 200-3(Dec. 1961).

The neutron capture cross sections of U^{238} are measured for monoenergetic neutrons in the energy range 0.30 to 1.7 Mev. (auth)

9235 THE PROBLEM OF PLASTICITY OF BERYLLIUM. E. Schmid, II (Universität, Vienna). Metall, 16: 1-4(Jan. 1962). (In German)

The physical properties of beryllium are reviewed. The temperature dependence of the Worth factors is compared with those of other reactor materials. The temperature dependence of the tensile strength and elongation of hot-pressed rods is shown. The structure of beryllium crystals is discussed. The brittleness of the beryllium is explained on the basis of the "two-dimensional" plasticity existing in the structure. Conditions necessary for the formation of this type of plasticity are described. The brittleness of the beryllium appeared to be caused both by crystal structure and impurities. (M.C.G.)

9236 EFFECT OF OXYGEN ON THE TEMPERATURE COEFFICIENT OF RESISTIVITY OF URANIUM MONOCARBIDE. L. B. Griffiths (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 193: 362 (Jan. 27, 1962).

The electrical resistivity of several specimens of uranium monocarbide was measured in an evacuated (10^{-3} mm mercury) vessel and in all cases found to be linear with temperature from 20 to 800°C. Spec-pure oxygen was then admitted to the tube covering a range of pressures from 5×10^{-6} to 5×10^{-4} mm mercury and each specimen heat-treated for 15 min at 450°C. It was necessary to raise the temperature to 450°C in order to obtain any change in resistivity within the time scale used. At the end of the soaking period the oxygen was pumped away in order to attain a base pressure of 10^{-5} mm mercury again, and resistivity re-measured as a function of temperature. It was concluded that oxygen in uranium monocarbide has a pronounced effect on electrical resistivity by (possibly) exciting electrons to a band where their mobility is high. The effect is not thought to be a surface phenomenon since no change could be obtained at temperatures less than 450°C. (P.C.H.)

9237 CERAMIC FUELS. P. Murray (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Eng., 7: 53-6(Feb. 1962).

A brief survey is given of the reactor fuels composed of uranium oxide, uranium monocarbide, and dispersed ceramic materials. The survey reveals that the situation on fission gas release in bulk uranium dioxide is now much clearer at center temperatures up to 1600°C. The preliminary data on the burn-up limits of bulk uranium dioxide give a general idea of the phenomena occurring. Results show that uranium monocarbide is suitable for liquid metal cooled reactors. On dispersed carbide fuels for good fission gas retention, recourse may be had to the coated particle concept. With oxide based fuels, dense matrices are possible at present which have good fission gas retention properties and promising behavior at high burn-up. (N.W.R.)

9238 THE FRACTURE OF LIQUIDS UNDER STRESS DUE TO IONIZING PARTICLES. B. Hahn (Univ. of Fribourg, Switzerland). Nuovo cimento (10), 22: 650-3 (Nov. 1, 1961). (In English)

An apparatus is described for applying hydrostatic tensile stresses to liquids, by rotating a straight capillary tube filled with the liquid around an axis perpendicular to its length. Exposure of the liquid to ionizing radiation during the stressing operation is found to decrease the amount of stress the liquid can take before "breaking." Application of these results to negative-pressure bubble chamber operation is discussed. (T.F.H.)

9239 THERMOELECTRICITY OF LITHIUM ALLOYS AT VERY LOW TEMPERATURES. D. K. C. MacDonald, W. B. Pearson, and I. M. Templeton (National Research Council, Ottawa). Phil. Mag. (8), 6: 1431-7(Dec. 1961).

As lithium is apparently the only alkali metal which will take heterovalent impurities into solid solution, alloys with Mg, In, and Al were prepared and their absolute thermoelectric power was examined from about 0.1 to 1.2°K. It is found that the change of diffusion thermoelectric power of lithium on alloying is in many ways surprising, and it is discussed whether the observed behavior may reasonably be attributed to the influence of conduction electron scattering or to a change in the electron density of states of lithium. (auth)

9240 THE PRESSURE DEPENDENCE OF THE THERMOELECTRIC POWER OF THE ALKALI METALS AT ROOM TEMPERATURE. J. S. Dugdale and J. N. Mundy (National Research Council, Ottawa). Phil. Mag. (8), 6: 1463-73(Dec. 1961).

The thermoelectric power S of the alkali metals was measured under pressures up to 3000 atmospheres at room temperature. A pressure of about 400 atmospheres causes S to change sign in cesium. The results are discussed in terms of the distortion of the Fermi surface under pressure. A relationship between S and the pressure coefficient of electrical resistivity is noted. (auth)

9241 EVIDENCE OF SINGLE-CRYSTAL CHARACTERISTICS IN HIGHLY ANNEALED PYROLYTIC GRAPHITE. C. A. Klein (Raytheon Co., Waltham, Mass.), W. D. Straub, and R. J. Diefendorf. Phys. Rev., 125: 468-70 (Jan. 15, 1962).

It is demonstrated that massive specimens of pyrolytic graphite heat-treated at 3600°C may exhibit electrical characteristics comparable to those of the best single crystals presently available. Low-field magnetoresistance data taken perpendicularly to the c direction of these specimens yield average carrier mobilities (1.3×10^4 $cm^2/v\text{-}sec$ at 300°K; up to 8×10^5 $cm^2/v\text{-}sec$ at 4.2°K) in agreement with results for the layer planes of highly purified natural graphite. In conjunction with temperature dependence studies of the zero-field resistivity, it is found that the carrier density reproduces the theoretically predicted behavior down to 77°K, but departs at lower temperatures. Plausible interpretations of this discrepancy and of the "knee" in the resistivity curve are discussed. (auth)

9242 PHOTOELECTRIC PROPERTIES OF NATURAL URANIUM AND CHANGES OCCURRING AT CRYSTALLOGRAPHIC TRANSFORMATIONS. Richard K. Fry and A. B. Cardwell (Kansas State Univ., Manhattan). Phys. Rev., 125: 471-4(Jan. 15, 1962).

Studies of the photoelectric properties of high-purity, carefully outgassed natural uranium were made through a wide temperature range, including 938 and 1043°K at which crystallographic transformations occur. Changes in the slope of the temperature-photoelectric current curves for monochromatic radiations are presented. Analysis of the data at different temperatures indicates changes in both the surface work function and the combined number density of free electrons and transition probability factor at the allotropic transformation temperatures. The work function of "clean" uranium was found to be 3.47, 3.52, and 3.39 ev, respectively, for orthorhombic (below 938°K), tetragonal (938 to 1043°K) and body-centered cubic (above 1043°K) uranium. (auth)

9243 THE EFFECT OF TEMPERATURE AND ALLOYING ADDITIONS ON THE DEFORMATION OF METAL CRYSTALS. R. W. K. Honeycombe (Univ. of Sheffield, Eng.). Progr. in Materials Sci., 9: 93-130 (1961).

A review is given on the relevant experimental results and theoretical concepts of the effects of temperature and alloying additions on the deformation of metal crystals. The review covers the influence of temperature and alloying elements on the stress to initiate plastic flow and the effect of these variables on the stress-strain curves. The bibliography contains 97 references. (N.W.R.)

9244 THE HYDROGEN EMBRITTLEMENT OF METALS. P. Cotterill (Battersea Coll. of Tech., London). Progr. in Materials Sci., 9: 201-301(1961).

A review is given of the characteristics and mechanisms of hydrogen embrittlement in the body centered-cubic metals (including steel), titanium and its alloys, alpha-zirconium, and alpha-uranium. These effects are discussed in terms of the present knowledge of the appropriate metal-hydrogen system and the theory of brittle fracture in metals. The bibliography contains 143 references. (N.W.R.)

9245 THE STRUCTURE AND PROPERTIES OF SOLID SOLUTIONS. J. M. Sivertsen and M. E. Nicholson (Univ. of Minnesota, Minneapolis). Progr. in Materials Sci., 9: 303-89(1961).

A review is given which described those aspects of the foundations and developments of the electron theory of solids which lead to a more complete understanding of primary solid solutions. The discussions give the important physical factors in the theory of solid solutions, the advances in the theory and applications, and the current views on the structure and properties of real solid solutions. One of the principal points of the discussion is the deviation in behavior of real solutions relative to the simple ideal ones. Experimental results on many metallic solid solutions are given. The bibliography contains 146 references. (N.W.R.)

9246 ALLOYS OF MAGNESIUM CONTAINING THORIUM. M. E. Drits, M. V. Mal'tsev, Z. A. Sviderskaya, and E. M. Padezhnova. Trudy Inst. Met., im. A. A. Baĭkova, No. 4, 74-83(1960).

Several binary and ternary magnesium–thorium alloys were investigated using additions of manganese, cerium, aluminum, zinc, calcium, and zirconium. The properties of magnesium–thorium alloys and also the effects of the additions on the properties at both room and elevated temperature were examined. The alloys were cast in a 20-mm diameter metallic mould heated to 50-60°C. The main method of investigating the properties consisted of short-time (30 sec) and long-time (60 min) hardness measurements. The hardnesses were measured at room temperature and 300°C using a 10-mm ball and a 100-kg load. The alloys were stabilized at 300°C for 100 hours before testing. Measurements were also made after quenching from 565°C. A marked increase occurred in the hardness of magnesium in the cast and stabilized conditions with increase in thorium content to 4%. Further increases in thorium content to 6–10% had little effect. The hardness decreased somewhat after the stabilization treatment. After quenching from 565°C, the hardness increased with increasing thorium content up to 10%. The prolonged hardness gave extremely high values. From microstructural and thermal analysis it was shown that the magnesium–thorium system is of the eutectic type. The eutectic consists of α-solid solution and the compound Mg_5Th, melting at 40-42% thorium and 580°C. The solubility of thorium at the eutectic temperature is 5% and at 300°C, 0.5%. Microhardness measurements showed that the hardness of the compound was 306 kg/mm^2, the eutectic was 118 kg/mm^2, and the solid solution was 74 kg/mm^2, corresponding to a hardness for magnesium of 47 kg/mm^2. The effect of the additions of the various elements was studied using an alloy containing 3% thorium. Cerium had the greatest effect on the properties at room temperature, the hardness continuously increasing up to 6% cerium. Calcium and zinc had a positive effect up to 0.5-1%, further additions showing no change. Low additions of manganese and aluminum gave a decrease in hardness. Further additions gave an increase. The greatest effect on the prolonged hardness at 300°C was shown by 0.6-1% manganese. Cerium also showed an increase, but to a lesser degree. (OTS)

9247 EFFECT OF BERYLLIUM ADDITION ON THE CASTING CHARACTERISTICS OF Al–10% Mg ALLOYS. M. R. Seshadri, S. Ramamurthy, and A. Ramachandran. p.307-21 of "Indian Institute of Science Golden Jubilee Research Volume, 1909-1959." Bangalore, India, Indian Institute of Science, 1959. (In English)

Results of experiments conducted to study the effect of small additions of beryllium on the casting characteristics of Al–10% Mg alloy reveal that addition of Be even as low as 0.05%, increases the spiral length by about 3 to 4 in. for a given pouring temperature; raises the casting quality from 88 to 96%; markedly increases the spiral length having uniform U.T.S. from 38 to 55%; improves the mechanical properties; virtually eliminates dross formation during melting; and prevents formation of black layer over the surface of the casting during heat treatment. (auth)

9248 IMPROVEMENTS IN COLUMBIUM-ZIRCONIUM ALLOYS. Stanley Thaddeus Wlodek, Edward Donald Weisert, and Peter Michael Moanfeldt (to Union Carbide Corp.). British Patent 889,191. Feb. 7, 1962.

An alloy which is resistant to oxidation at temperatures up to >950°C and is workable by heat treatment may be made from Nb, Zr, and some or all of the group Al, V, Ti, Be, Mg, Si, Ba, Sn, and a rare earth metal. The preferred proportions of the constituents are 25 to 40 wt % Zr, ≥50 wt % Nb, 0 to 6 wt % Al, 0 to 5 wt % V, 0 to 20 wt % Ti, 0 to 3 wt % Be, 0 to 3 wt % Mg, 0 to 3 wt % Si, 0 to 3 wt % Ba, 0 to 5 wt % Sn, and 0 to 3 wt % of a rare earth metal. Examples of the alloys and their oxidation resistance at 1000°C are given for Nb–Ti–Zr, Al–Nb–Zr, Al–Nb–Ti–Zr, Al–Nb–Ti–V–Zr, Nb–Zr, Al–Nb–Sn–Ti–V–Zr, Al–Ba–Nb–Ti–Zr, and Al–Nb–Sn–Ti–Zr. (D.L.C.)

9249 BRAZING ALLOYS. R. G. Donnelly, R. G. Gilliland, and G. M. Slaughter (to U. S. Atomic Energy Commission). U. S. Patent 3,022,162. Feb. 20, 1962.

A brazing alloy is described which, in the molten state, is characterized by excellent wettability and flowability and is capable of forming a corrosion-resistant brazed joint. At least one component of said joint is graphite and the other component is a corrosion-resistant refractory metal. The brazing alloy consists essentially of 40 to 90 wt % of gold, 5 to 35 wt % of nickel, and 1 to 45 wt % of tantalum. (AEC)

Radiation Effects

Refer also to abstract 9655.

9250 (AD-239510) DETERMINING THE FUNCTIONAL PROPERTIES OF FOOD CONTAINERS USED FOR FOODS IRRADIATED IN COMBINATION WITH MODEL FOOD SYSTEMS. Report No. 19 (Progress), July 25, 1959–September 24, 1959. Charles E. Feazel (Southern Research Inst., Birmingham, Ala.). Contract DA-19-129-QM-759. 22p.

The object of this work was to study the factors that affect stress-cracking and the production of extractives in plastic packaging materials that are to be used with foods preserved by irradiation. Polystyrenes, polyamides, polyesters, and polypropylenes were tested in homogenized milk, in solutions of Igepal CO-630 and solutions of lactic acid, and in water slurries of ground beef, ground pork, pork sausage, cheese, fish, apples, and green beans. All materials, except polyesters received 1.0, 3.0, and 6.0 megarads of gamma radiation. Polyesters received 6.0 megarads of gamma radiation only. Unirradiated samples were also tested with the solutions. The super-high shock resistant polystyrenes were the most resistant to stress-cracking; irradiation increased their resistance further. Sausage and cheese slurries caused the most stress-cracking of polystyrenes; Igepal CO-630 and lactic acid solutions affected only a few of the polystyrenes. Polyesters, polyamides, and polypropylene were not affected by any of the media. Polyesters irradiated in water had no off odor. There was a correlation between the amount of rubber present and the odor of irradiated polystyrenes. (auth)

9251 (AERE-R-3787) LONG TERM REACTIVITY CHANGES IN WINDSCALE AND NRX IRRADIATED URANIUM BARS. W. A. Cooper, H. Rose, and J. J. Syrett (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1961. 29p.

Declassified version of AERE-R/R-2311, July 3, 1956.

The Gleep oscillator is used to measure the changes in apparent cross section of Windscale and NRX natural uranium bars after neutron irradiation. The Windscale uranium received irradiations up to a maximum of about 1200 Mwd/t, and that for NRX up to the region of 2400 Mwd/t. The results are discussed in terms of the growth and destruction of heavy isotopes and fission products taking place during the neutron irradiation. (auth)

9252 (ARF-1164-21) RESEARCH STUDY ON NEUTRON INTERACTIONS IN MATTER AS RELATED TO IMAGE FORMATION. Period Covered, October 1, 1961 – December 31, 1961. H. V. Watts (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 26, 1962. Contract AT(11-1)-578. 24p.

Research was carried out to find optimum characteristics (sensitivity and resolution) of neutron image detector systems compatible with the image quality for various neutron radiographic objects, which may include a significant neutron scattering component. The characteristics of the following thermal neutron imaging detectors are summarized in tabular form: activation foils with x-ray films; B^{10} and Li^6 loaded phosphors; bundles of rods of neutron scintillators; multiwire spark chambers; and an array of semiconductor detectors. The lithium fluoride–zinc sulfide phosphor screens by virtue of their simplicity, good neutron sensitivity, low gamma sensitivity, and fair resolution, appeared to be promising for much general work. Experimental data are presented illustrating the use of opal glass diffusers as optical analogs for phosphor screens on the optical image synthesis apparatus. This image synthesis apparatus is being used to study the image quality as a function of the detector resolution and the neutron scattering in the radiographic object. The new five inch diameter neutron beam exposure facility is described. In this facility neutron radiographs of various items are being obtained. These radiographs are to be compared with x-ray radiographs to illustrate the applications of neutron imaging. (auth)

9253 (DC-59-6-195) TEST LTNCMR-1. R. C. Lee (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 28, 1959. Contract AT(11-1)-171. 41p.

A test is described to determine the physical integrity of an advanced-type nichrome-molybdenum fuel element, and the thermocouple attachment method used on the specimen under LITR conditions. The fuel specimen was a single cylinder containing 3.14 g of U^{235} as UO_2. The test operated for 90.5 hours at 2100°F, including 8 hours at reduced reactor power. During this time five reactor shutdowns and two setbacks caused thermal cycling of the specimen. The exit air activity remained constant for over 50 hours, then increased slowly, until high activity caused the test to be terminated. The total neutron dosage received by the specimen was 5.06×10^{18} nvt. (auth)

9254 (DOFL-TR-975(Vol.I, Pt.1)) NUCLEAR RADIATION DAMAGE TO TRANSISTORS. VOLUME I: PERMANENT DAMAGE. PART 1: DATA. Robert Puttcamp (Diamond Ordnance Fuze Labs., Washington, D. C.). Nov. 27, 1961. 162p.

Permanent damage data (including graphical and tabular results) are presented on 18 types of transistors. Germanium and silicon (PNP and NPN) junction transistors and a germanium surface-barrier type transistor are covered. The units are irradiated in a fast neutron environment and are observed for effects on small-signal beta and collector leakage current. The results indicate that the amount of induced permanent damage is directly proportional to the power rating of the transistor, and inversely proportional to the alpha-cutoff frequency. (auth)

9255 (DP-667) IRRADIATION OF A URANIUM METAL FUEL TUBE AT CHALK RIVER. Richard C. Pugh (Du Pont de Nemours (E. I.) and Co. Savannah River Lab., Aiken, S. C.). Nov. 1961. Contract AT(07-2)-1. 12p.

A 2-inch-diameter by 11-foot-long coextruded tube of Zircaloy-clad uranium metal was irradiated to an exposure of 955 Mwd/t at a maximum core temperature of 400°C in a pressurized water loop of the NRU Reactor at Chalk River. The purpose of the irradiation was to obtain preliminary data on the stability of such fuel at temperature and pressure conditions approximating those expected in a heavy-water-moderated power reactor. The maximum volume change of the uranium fuel was 1.5 per cent. The maximum cladding strain was 0.19 per cent. (auth)

9256 (FXM-3389) RADIATION CREEP. D. P. Gregory ([Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown]). Dec. 5, 1957. 7p.

Several theories of metal creep and radiation damage are studied, in order to determine whether creep rates under various conditions of irradiation can be predicted theoretically. It is found that if the creep is of the recovery type, and if the diffusion coefficient for radiation-induced vacancies is large enough, creep rates may be increased within a limited temperature range. Otherwise, radiation has no effect on creep rates. (T.F.H.)

9257 (FXM-3932) CREEP RUPTURE IN THE PRESENCE OF A FAST NEUTRON FLUX. D. P. Gregory ([Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown]). Jan. 14, 1959. 5p.

Possible mechanisms for creep rupture during irradiation are examined. Evidence that the rupture occurs by grain boundary sliding alone, or by vacancy condensation, is compared. It is observed that vacancy condensation is the more probable mechanism, and that this mechanism predicts a reduction in creep rupture life for metals exposed to a fast neutron flux (neglecting effects of radiation annealing). (T.F.H.)

9258 (GA-2886) MECHANISMS OF TRANSIENT RADIATION EFFECTS. STATE OF THE ART. V. A. J. Van Lint (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Jan. 1962. Contract DA-49-186-ORD-939. 14p.

Presented at 5th annual meeting of Weapon Effects Board Panel on Transient Radiation Effects on Electronics, sponsored by DASA, Washington, D. C., Jan. 29–Feb. 2, 1962.

Processes by which electrons are excited and de-excited in various materials are discussed. The macroscopic physical manifestations of these electronic perturbations are described and the transient effects correlated with the type of incident radiation. Finally, typical transient effects in electronic components are given. (D.L.C.)

9259 (HW-69393) SWELLING IN URANIUM: A COMPARISON OF THE EFFECTS OF IRRADIATION AND POSTIRRADIATION ANNEALING. T. K. Bierlein, R. D. Leggett, B. Mastel, and J. W. Weber (General Electric Co. Hanford Atomic Products Operation, Richland Wash.). Apr. 1961. Contract AT(45-1)-1350. 18p.

The swelling in Zircaloy-2 clad rods of uranium irradiated under conditions of low restraint was compared with the swelling during the ex-reactor annealing of uranium irradiated under conditions of high restraint. A surprising agreement existed in the volume changes observed during the two types of experiments. For similar burn-up levels, the in-reactor and ex-reactor studies led to identical relationships between swelling and temperature. The measurements and the data analyses suggested that post-irradiation annealing may serve as a simple means for estimating the magnitude of in-reactor swelling. (auth)

9260 (KAPL-M-EEB-17) EFFECT OF NEUTRON IRRADIATION IN HIGH TEMPERATURE WATER ON THE MECHANICAL PROPERTIES AND CORROSION BEHAVIOR OF WROUGHT AND WELDED INCONEL. Status Report No. 1. E. E. Baldwin and A. E. Dinerman (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 1, 1961. Contract W-31-109-Eng-52. 57p.

A program is currently in progress to determine the effect of neutron irradiation and a high temperature water environment on the mechanical properties and corrosion behavior of Inconel wrought material and weld metal. Tensile and impact specimens were inserted in the F-10 loop on April 1, 1959, and tensile specimens were removed from the in and out-of-pile positions of the loop and examined and tested after exposures to 2.6 and 3.2×10^{20} nvt (fast). The results indicate that the mechanical properties and corrosion behavior are similar to that exhibited by 347 stainless steel subjected to the same exposure. The program is being continued until specimens have received a maximum exposure of 1×10^{22} nvt (fast). (auth)

9261 (NARF-61-42T) IRRADIATION TESTS OF SELECTED TRANSDUCERS. E. W. Bradford (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Dec. 15, 1961. Contract AF33(657)-7201. 57p. (MR-N-265)

A number of instrumentation transducers were irradiated for the purpose of finding commercially available transducers that can be used in a radiation environment. The tests were made at ambient temperature and humidity conditions. The pickups were "exercised" during irradiation to simulate operating conditions. The pickups tested included differential transformers; fluid-damped and magnetic-damped velocity pickups; strain gages; piezoelectric accelerometers; bulb resistance thermometers; and inductive, strain-gage, and potentiometer pressure pickups. Potentiometer pressure pickups, magnetic-damped velocity pickups, and piezoelectric accelerometers operated satisfactorily in the radiation environment. (auth)

9262 (NP-11336) MONTHLY ACCESSION LIST 54 [ON RADIATION EFFECTS DATA]. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Jan. 15, 1962. 24p.

Annotated citations are given for 68 references to reports and published information on organic and inorganic compounds, electronics, polymers, metals, dosimetry, facilities, and space environments. (T.F.H.)

9263 (NRL-5731) EFFECTS OF NUCLEAR RADIATION ON THE PROPERTIES OF REACTOR STRUCTURAL MATERIALS. J. R. Hawthorne, L. E. Steele, and W. S. Pellini (Naval Research Lab., Washington, D. C.). Nov. 16, 1961. 18p.

Recent findings on the notch ductility of irradiated pressure vessel steels are reviewed, and the influence of nuclear exposure variables are evaluated. The available data indicated that exposure of these steels to moderate neutron dosages ($n/cm^2 > 1.0$ Mev) will result in a major change in notch ductility and that neutron dosage and irradiation temperature are the primary factors controlling this process. Specific influences involving neutron spectrum and neutron dose rate ($n/cm^2/sec$) were not detected; however, environmental differences in the test-reactor facilities utilized are not considered sufficient to eliminate the possibility of the existence of such effects. The recovery of notch-ductility properties of steels by post-irradiation heat treatment was explored. Although this technique appeared promising for practical applications, a time-dependent re-embrittlement phenomenon was discovered which restricts the choice of heat treatment. Variables of the recovery process were considered in relation to the recovery characteristics of A212B and A302B steels. (auth)

9264 (TID-14001) ANNUAL REPORT [ON RADIATION EFFECTS ON SOLIDS], 1961. Rohn Truell [(Brown Univ., Providence)]. Contract AT(30-1)-1772. 33p.

Progress is reported on studies of radioinduced defects in natural quartz by high-frequency ultrasonic methods; the effects of deformation and temperature on ultrasonic attenuation and velocity measurements of the gamma irradiation effects on single crystal sodium chloride; and the gamma irradiation effects on single crystal aluminum in studies of the dislocation damping theory. (B.O.G.)

9265 (TID-14482) IRRADIATION DAMAGE TO GLASS. Joseph A. Aboaf, J. Raymond Hensler, Norbert J. Kreidl, Eberhardt Lell, and Joseph L. Rood (Bausch and Lomb Inc., Rochester, N. Y.). Nov. 1961. Contract AT(30-1)-1312. 23p.

Discharge experiments on electron-irradiated lead silicate glasses were performed. The light flashes observed during the discharge are divided into three types: discharge with mechanical damage to the glass, spontaneous flashes of light observed after the specimen was discharged mechanically, and the light flash when the glass was hit by a pointed object. Electrical discharge in glass following gamma irradiation was found to occur only when the gamma beam strikes the glass from one direction only. Dielectric constants were measured for irradiated glass. Studies are also being made of irradiation of highly compressed glass. Three additional glasses protected against radioinduced changes in absorption were developed. (M.C.G.)

9266 (TID-14693) BASIC RADIATION DAMAGE STUDIES TECHNICAL PROGRESS REPORT. (Purdue Research Foundation, Lafayette, Ind.). Dec. 15, 1961. Contract AT(11-1)-125. 11p.

Progress is reported on developments in the studies of the effects of electron irradiations on the properties of germanium specimens, and studies of the recovery of the specimens from the effects of the electron bombardments. (B.O.G.)

9267 (TID-14951) RADIATION EFFECT OF POSITIVE ION BOMBARDMENT. Progress Report, September 16, 1961–December 15, 1961. R. L. Hines (Northwestern Univ., Evanston, Ill.). Jan. 21, 1962. Contract AT(11-1)-1053. 4p.

Preliminary experiments were carried out to determine the ranges of D_2^+ and D^+ in Cu. The ion source was modified and trial preparation of Cu films on quartz was successful. An analysis was made of the reflection coefficient vs. wavelength curves of quartz covered with a given metal film thickness and bombarded at a given flux and several different energies. The expected reflection coefficients were calculated for a large number of residual quartz ranges and straggling parameters. By matching the experimental curves of reflection coefficient vs. energy/wavelength, the energy was determined which gives a range equal to the metal film thickness. (M.C.G.)

9268 (HW-TR-31) ACTION OF GAMMA RAYS ON POLYMERS IN THE SOLID STATE. Adolphe Chapiro. Translated by Liz Appleby (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.) from J. chim. phys., 52: 246-58(1955). 41p.

The crosslinking of polyethylene subjected to gamma radiation was followed by measuring the melting point of

the irradiated polymer. For this, equipment was developed to measure the curves of elongation under constant load as a function of time and to determine the breaking temperature of small polymer specimens. The production of cross-linking was studied for different radiation intensities, in the presence and absence of air. The results show that, in the presence of air, the dose required to make polyethylene infusible is 2 5 Mr if irradiations are made at intensities greater than 400 r/min. If the radiation intensity is less than 100 r/min, an oxidizing degradation of the polymer is observed. In order to interpret the observed phenomena, assumptions were made for the formation of intermolecular bonds with peroxide structure which are decomposed near 150 to 170°. If the irradiation is done in vacuum or in a nitrogen atmosphere with previously degassed specimens, the polyethylene becomes infusible after a dose of 1 Mr, whatever the intensity of the radiation. The results are discussed within the bounds of the theories proposed by other authors, and it is concluded that the radiochemical yields of the reaction have the following values: G_{bonds}^{air} = 0.75 bonds per 100 eV, G_{bonds}^{vacuum} = 1.9 bonds per 100 eV, and G_R = 5.1 primary radicals per 100 eV. (auth)

9269 THE OXIDATION AND RELEASE OF IODINE-131 FROM URANIUM SLUGS OXIDIZING IN AIR AND CARBON DIOXIDE. W. J. Megaw, R. C. Chadwick, A. C. Wells, and J. E. Bridges (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 15: 176-84(Dec. 1961).

Experiments to determine the oxidation rate, particle size distribution of oxide, and release of I^{131} from one kilogram, trace irradiated uranium slugs oxidizing at temperatures up to 1000°C in air and carbon dioxide are described. The release of iodine as a result of rapid melting of uranium is also investigated. It is concluded that extensive release of elemental iodine as vapor is always accompanied by extensive oxidation and that for temperatures below the melting point the release of elemental iodine as vapor is greater for oxidation in air than in carbon dioxide. It is stressed that for the geometrical arrangement and gas velocities used the greater part of the iodine inventory of the uranium remains contained in or adsorbed on particles of uranium oxide. (auth)

9270 ON MAGNETIC AND LUMINESCENT CENTRES INDUCED IN THE CRYSTAL OF LITHIUM FLUORIDE BY X-RAY IRRADIATION. A. Choudhury (Jadavpur Univ., Calcutta). Nuovo cimento (10), 22: 457-61(Nov. 1, 1961). (In English)

The diamagnetic susceptibility of LiF decreases on irradiation with x rays. The difference in diamagnetic susceptibility of the sample before and after coloration obeys the Curie law. This is because of the paramagnetism of induced color centers, predominantly F centers. On complete thermal bleaching the diamagnetic susceptibility recovers its original value. The changes in magnetic susceptibilities that occur at different stages of thermal bleaching are found to have close correspondence with the integrated intensity of thermoluminescence emission. It is concluded from the results that the destruction of F centers alone cannot account for the intensity of thermoluminescence emission or magnetic changes. (auth)

9271 THE BEHAVIOUR OF POINT DEFECT CLUSTERS IN IRRADIATED METALS. R. S. Barnes (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8), 6: 1487-92(Dec. 1961). (AERE-R-3751)

A simple model, where clusters of interstitial atoms compete with the equivalent number of vacancies left in the crystal for subsequent interstitial atoms, is used to discuss the rate of accumulation of the vacancies and the conditions governing the size of the interstitial atom clusters. Recombination becomes important at an interstitial cluster size which is dependent upon the relative interaction distances of interstitial atoms with vacancies and dislocation lines. (auth)

9272 POLARIZATION OF Li NUCLEI IN IRRADIATED LiH. R. T. Schumacher and J. L. Hall (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev., 125: 428-32(Jan. 15, 1962).

The electron spin resonance in colloidal lithium metal produced in ultraviolet-irradiated LiH was investigated at room temperature. The "Overhauser shift" of the electron resonance frequency due to nuclear polarization may be observed. By an electron-nuclear double resonance experiment it is shown that the polarization of the metallic lithium nuclei probably causes polarization of the lithium in the neighboring nonmetallic regions, i.e., the nonmetallic nuclei are in thermal contact with the nuclei in the metal, and tend to come to the same spin temperature. (auth)

9273 ELECTRON SPIN RESONANCE OF RADIATION-INDUCED DEFECTS IN POTASSIUM AZIDE. D. W. Wylie (Univ. of Connecticut, Storrs), A. J. Shuskus, C. G. Young, O. R. Gilliam, and Paul W. Levy. Phys. Rev., 125: 451-3 (Jan. 15, 1962). (BNL-5629)

Trapped nitrogen atoms and N_2^- molecule ions were detected in potassium azide (KN_3) by electron spin resonance measurements at 77°K following gamma irradiation at this temperature. The nitrogen atom has effective spin $S = \frac{3}{2}$, and each fine structure component shows the hyperfine pattern of a single N^{14} nucleus. The atoms are trapped in two magnetic sites having rhombic symmetry. These are equivalent under a 90° rotation about [001]. Choosing z||[110], x||[1$\bar{1}$0], and y||[001], the results can be fitted to the spin-Hamiltonian, $\mathcal{H} = |\beta|\mathbf{H}\cdot\mathbf{g}\cdot\mathbf{S} + D(S_z^2 + E(S_x^2 - S_y^2) + \mathbf{A}\mathbf{I}\cdot\mathbf{S}$, where $g = 2.001 \pm 0.001$, $D = +0.0143 \pm 0.0001$ cm^{-1}, $E = -0.00199 \pm 0.00002$ cm^{-1}, and $A = 0.00051 \pm 0.00002$ cm^{-1}. The other defect, attributed to N_2^-, has a spectrum characteristic of a single unpaired electron and a hyperfine pattern corresponding to two equivalent nitrogen nuclei, and is located in two equally populated magnetic sites related by a 90° rotation about [001]. For one site and the same choice of axes, $g_x = 2.001 \pm 0.002$, $g_y = 2.001 \pm 0.001$, and $g_z = 1.984 \pm 0.001$; $A_x = 0.0006 \pm 0.0002$ cm^{-1} and $A_y = A_z = 0.00037 \pm 0.00002$ cm^{-1}. The annealing behavior of these defects is related to the growth of the N_4^- molecule ion previously reported. (auth)

PHYSICS

General and Miscellaneous

Refer also to abstract 9114, 9115, and 9116

9274 (AERE-T/M-132) SYMMETRY CLASSIFICATION OF ONE-ELECTRON WAVE-FUNCTIONS FOR ALPHA-URANIUM. D. F. Johnston (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1956. 22p.

The one-electron wave-functions belonging to the α-uranium lattice are classified in symmetry types. The transformation properties of the wave-functions under the symmetry operations of the crystal are given for each type of function. No account is taken of spin-orbit interactions. (auth)

9275 (AFOSR-1932) K X-RAY FLUORESCENCE YIELD OF ARGON. Research Report No. 10. Takeshi Watanabe, H. W. Schnopper, and F. N. Cirillo (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). Dec. 19, 1961. Contract AF49(638)-402. 16p.

The K x-ray fluorescence yield of Ar is measured to be $14 \pm 1.4\%$. This value is obtained from the "escape peak" in the pulse-height distribution of a flow proportional counter with monochromatic x rays. Fe^{55} is used as the primary x-ray source. Corrections are made for the L and M ionizations, for the reabsorption of the K fluorescent x rays, and for background counts. (auth)

9276 (AFSWC-TR-61-91) STUDIES AND EXPERIMENTAL WORK ON ATOMIC COLLISION PROCESSES OCCURRING IN ATMOSPHERIC GASES. Final Report. A. V. Phelps and M. A. Biondi (Westinghouse Electric Corp. Research Labs., Pittsburgh). Oct. 30, 1961. Contract AF29(601)-2790. 53p.

Results of measurements of the collisional detachment of electrons from oxygen negative ions are presented. It is shown that the electron affinity of O_2^- is 0.44 ± 0.02 ev. A discussion of low pressure measurements is presented, where the product of the attachment coefficient and detachment frequency is determined from the ratio of the detached electron current to the current of electrons which cross the drift tube without attaching to the gas. A discussion of the high pressure technique is given in which the ratio of the detachment frequency to the attachment coefficient is obtained from measurements of the ion and electron drift velocity. A treatment of the attempt to assign an energy scale to drift tube data is presented. The present state of this field is briefly reviewed and recommendations for future work are made. (auth)

9277 (ANL-6455) PHYSICS DIVISION SUMMARY REPORT, NOVEMBER–DECEMBER 1961. (Argonne National Lab., Ill.). Contract W-31-109-Eng-38. 99p.

Progress is reported on experimental nuclear physics, mass spectroscopy, plasma physics, and theoretical physics. Differential cross sections for neutron resonance scattering, nuclear resonance absorption of gamma rays, scattering of charged particles, molecular beam studies, semiconductor detectors, high-temperature diffusion cloud chamber, principles of cyclic particle accelerators, gaseous species in equilibrium at high temperatures, consecutive ion-molecule reactions, high-frequency plasmas, relative β-decay probabilities for K^{40}, and flux quantization and the current carrying state in a superconducting cylinder are discussed. (M.C.G.)

9278 (ANL-6465) THERMIONIC ENERGY CONVERSION DIODE USING A FILM BOILING LIQUID METAL ANODE. Progress Report from February 1961 to September 1961. A. J. Ulrich (Argonne National Lab., Ill.). Dec. 1961. Contract W-31-109-eng-38. 11p.

The conventional plasma thermocouple or thermionic energy conversion diode has a solid metal anode. Cs vapor at a pressure of a few millibars or less is widely used to provide ions for electron space charge neutralization. Usually, conditions are such that a monolayer of Cs coats the anode, so that electrically the anode appears to be Cs. This suggests the use of a diode with a liquid metal anode material such as Cs, Rb, or K, and their alloys. Recent experiments showed that a diode, consisting of a hot cathode and a liquid metal anode separated by the vapor film created in film boiling, can be produced. Data are given. Experiments investigating the electrical characteristics of film boiling using water are described. (auth)

9279 (DESY-A2.79) FORMELN ZUR RELATIVISTISCHEN KINEMATIK. (Formulas for Relativistic Kinematics). P. Beckmann and J. v. Behr (Deutsches Elektronen-Synchrotron, Hamburg). Oct. 20, 1961. 9p.

Formulas are given for the following properties of particles: mass, energy, kinetic energy, momentum, velocity, Lorentz factor, momentum angle, total energy, sum of momenta, sum of CMS velocities, and transformations between laboratory systems and CMS. Transformations of effective cross sections and isotropic line spectra are considered. (D.L.C.)

9280 (ERR-AN-072) LOW-ENERGY SPUTTERING STUDIES. Annual Report, July 15, 1960 to July 14, 1961. Daniel McKeown, Amado Cabezas, and Edward T. MacKenzie (General Dynamics/Astronautics, San Diego, Calif.). July 14, 1961. Contract Nonr-3157(00). 48p.

A study is made on the sputtering of gold and aluminum by beams of noble gases at normal incidence between 0 and 1000 ev. Gold is bombarded by He^+, Ne^+, Ar^+, and Xe^+, and aluminum by Ne^+, Ar^+, and Kr^+. Sputtering is measured by the crystal oscillator method. Using 20-Mc crystals in the oscillator, it is possible to detect the average removal of 0.01 angstrom from a surface by sputtering. Secondary electron emission from the target is suppressed, and sputtering yields (μ) are given in atoms per ion. The increase in μ with beam energy is a nearly linear function in terms of $\mu/(1 + \gamma)$, where γ is the number of secondary electrons emitted per incident ion. The experimental results are analyzed in the light of theories on sputtering yields and thresholds. (auth)

9281 (HW-66262) AN INTERCOMPARISON OF ADIABATIC CALORIMETRY AND COINCIDENCE COUNTING FOR THE ACTIVITY DETERMINATION OF A COBALT-60 SOURCE. W. H. Le Blanc, I. T. Myers, and D. M. Fleming (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 29, 1960. Contract AT(45-1)-1350. 24p.

A half-curie Co^{60} source was calibrated by total absorption adiabatic calorimetry. The mean value of the source activity measured calorimetrically was 1.73% less than the value obtained by the United States Bureau of Standards by coincidence measurements. Apparatus is described which maintained adiabatic control between the bath and calorimeter within ± 0.0003°C. (auth)

9282 (IS-386) THE MASS SPECTRA OF SOME VOLATILE HYDRIDES. Fred Eric Saalfeld and Harry J.

Svec (Ames Lab., Ames, Iowa). Nov. 1961. Contract [W-7405-eng-82]. 123p.

The hydrides of groups IVB and VB, except C, N, Pb, and Bi, were prepared and analyzed in the mass spectrometer. Fragmentary evidence for a new hydride Sb_2H_4 is reported. The fragmentation patterns and appearance potentials were measured and the bond energies and heats of formation calculated. (auth)

9283 (NASA-TN-D-1187) EVALUATION OF A HOLLOW, CYLINDRICAL, CONTACT-ION SOURCE. J. Thomas Kotnik (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Feb. 1962. 28p.

An analysis is presented to determine the ion current that can be obtained from a hollow, cylindrical, contact-ionization source having a longitudinal potential gradient. The analysis is verified by comparison with experimental data obtained by ionization of cesium vapor on a hot, cylindrical platinum film with an applied longitudinal potential gradient. Since the maximum obtainable current density was less that 1 amp/m^2, this ion source does not appear to be useful for electrostatic rocket engines. (auth)

9284 (NBS-TN-109) A COMPILATION OF THE PHYSICAL EQUILIBRIA AND RELATED PROPERTIES OF THE HYDROGEN–HELIUM SYSTEM. Dennis E. Drayer and Thomas M. Flynn (National Bureau of Standards. Boulder Labs., Boulder, Colo.). June 1961. 55p. (PB-161610)

K-factors are calculated for the helium–hydrogen system over the ranges 17.4 to 21.8°K and 2 to 32 atmospheres K-factors are presented graphically for three isotherms over this range. A bibliography of approximately 290 references is also presented on related properties for this system and for the pure components. (auth)

9285 (NBS-TN-116) ASTROPHYSICAL AND PLASMA PHYSICS RESEARCH AT THE NATIONAL BUREAU OF STANDARDS HIGHLIGHTS FOR 1961. L. M. Branscomb, K. E. Shuler, and J. A. Suddeth (National Bureau of Standards, Washington, D. C.). Oct. 1961. 42p. (PB-161617)

Astrophysical and plasma physics research is reviewed. A bibliography of 280 selected published articles is included. (auth)

9286 (NBS-TN-120) A TABULATION OF THE THERMODYNAMIC PROPERTIES OF NORMAL HYDROGEN FROM LOW TEMPERATURES TO 300°K AND FROM 1 TO 100 ATMOSPHERES. John W. Dean (National Bureau of Standards, Boulder Labs., Boulder, Colo.). Nov. 1961. 74p. (PB-161621)

Pressure, volume, temperature, internal energy, enthalpy, and entropy of normal hydrogen gas are tabulated along isobars in 1°K temperature steps. The range covered is from the saturation temperature to 300°K and from a pressure of 1 to 100 atmospheres. The source of data is the Research Paper 1932 of the National Bureau of Standards Journal of Research. The method is described by which the data presented in Research Paper 1932 is reduced to properties directly useful for engineering calculations. A method is also described for estimating the effect of ortho-para compositions upon the tabulated properties. Tabular values are presented in the dimensional units of the metric system. The tabulations are also available in the dimensional units of the British system as Technical Note No. 120, Supplement A. (auth)

9287 (NP-11285) INVESTIGATION OF HIGH VELOCITY IMPACT AND SOME HIGH EXPLOSIVES PHENOMENA. Final Report. R. T. Keyes (Utah. Univ., Salt Lake City. Inst. of Metals and Explosives Research). Dec. 1, 1961. Contract AF18(603)-100. 50p.

A brief summary of the important results is given. The subject matter covered by the investigations included: (1) high explosive generators for fast particles, (2) mechanism of cratering in ultra high velocity impact, (3) observations of vaporization accompanying ultra high velocity impact, (4) mechanism for crater expansion in shaped change penetration, (5) ionization and electron densities in detonating solid explosives, (6) electrical fields and electromagnetic radiation from chemical detonations, (7) external detonation generated plasmas, (8) the effect of pressure on the degree of ionization in gaseous detonations, (9) ionization and electrical conductivity and its relationship to the deflagration to detonation transition in solid explosives, and (10) transition to detonation in liquid explosives. (auth)

9288 (NP-11302) DIRECT ENERGY CONVERSION LITERATURE ABSTRACTS. Mildred Benton, comp. (Naval Research Lab., Washington, D. C.). Sept. 1961. 208p.

A collection of 1044 references from various sources covering the current literature on thermoelectricity, thermionic emission, photoelectric processes, magnetohydrodynamics, electrochemical processes, energy storage, and energy sources is presented. An author index is included. (auth)

9289 (NP-11315) IMAGES OF THE FERMI SURFACE IN PHONON SPECTRA OF METALS. Technical Report No. 8. E. J. Woll, Jr. and W. Kohn (California. Univ., La Jolla). Contract NONR-2216 (11). 23p.

Thesis by E. J. Woll, Jr. submitted to the Carnegie Inst. of Tech., Pittsburgh.

Semi-quantitative considerations concerning images of the Fermi surfaces in the phonon spectra of various metals are presented. Anomalies in the phonon dispersion curves. as well as discontinuities of the phonon lifetime, are discussed. (auth)

9290 (NYO-9764) PROGRESS REPORT ON THE MACH REFLECTION CALCULATION. Robert D. Richtmyer (New York Univ., New York. Atomic Energy Commission Computing and Applied Mathematics Center). Sept. 15, 1961. Contract AT(30-1)-1480. 69p.

Mathematical methods are being developed for calculations in fluid dynamics. The work to date on the Mach reflection calculation is summarized. In the flow there are two curved shocks, a slip surface, a plane shock, and rigid walls. The desired solution of the fluid-dynamics equations is stationary in similarity variables; approximate initital data are therefore assumed, with the expectation that the flow will settle down to the desired one asymptotically. The Eulerian equations for the smooth parts of the flow are coupled to the jump and boundary conditions on the various surfaces. Two-dimensional fitting procedures were devised to apply the jump and boundary conditions. All parts of the code now appear to operate satisfactorily except for the treatment of the slip surface, which showed instabilities after about 50-70 cycles. The main problem was temporarily discontinued, in order to concentrate on the slip surface. A simplified problem of a nearly plane slip surface between parallel walls and with a periodicity condition along the surface is described. This problem uses all the machinery of the main code except for the parts having to do with the shocks, and it has additional subroutines for computing an analytic solution based on the linearized theory of Helmholtz instability

modified by compressibility, surface tension, and the presence of the walls. These subroutines provide initial data and automatic subsequent comparison of the numerical and analytic solutions. Illustrative analytic results are presented. Complex arithmetic is used in the analytic work. A number of ways are indicated in which it is planned to improve the over-all formulation at the time of conversion to or recoding for the 7090. (auth)

9291 (TID-14860) THE DETERMINATION OF LOW ENERGY X-RAY ATTENUATION COEFFICIENTS FOR LOW Z ELEMENTS (thesis). Randall W. Carter (Vanderbilt Univ., Nashville. Graduate School). June 1958. 43p.

A proportional spectrometer was used to determine attenuation coefficients of low-energy x rays for low-z elements in the energy range from 6 to 14 kev. Curves were obtained for attenuation coefficient versus energy and whenever possible the measurements were extended below the threshold energy for creating K-shell ionizations. The K-jump ratio was determined by measuring the attenuation coefficients immediately above and below the threshold energy for creating K-shell ionizations. The attenuation coefficients were found to have a probable error in the range from 1.10 to 2.47%. (M.C.G.)

9292 (TID-14870) ON THE EQUATION OF STATE FOR WATER AND WATER VAPOR IN THE CRITICAL REGION. Technical Report No. 11. E. S. Nowak and R. J. Grosh (Purdue Univ., Lafayette, Ind. School of Mechanical Engineering). Nov. 1961. Contract AT(11-1)-1026. 89p.

A parametric equation of state was derived for water vapor in the critical region. It is valid for pressures ranging from 3000 to 4000 psia, specific volumes from 0.8 V_c to 2 V_c and temperatures from saturation to 752°F. The equation satisfies the following boundary conditions at the critical point, $(\partial P/\partial V)_{T_c} = (\partial^2 P/\partial V^2)_{T_c} = 0$, $(\partial P/\partial T)_{V_c} = (dP_s/dT)_{T_c}$, and $(\partial^2 P/\partial T^2)_{V_c} = 0$. The maximum deviation between computed and measured values of pressure of three parts in one thousand coincides approximately with the over-all uncertainty in P-V-T measurements. By utilizing certain concepts in "Clausius Theorem of the Virial" the size of water molecule was estimated as 2.61 A from P-V-T data. This is in fair agreements with other estimated values which ranged from two to five Angstroms. (auth)

9293 (USCEC-83-210) THE DISTRIBUTION OF CHARGED PARTICLES NEAR A CHARGED SPHERICAL BODY IN MOTION. Toyoki Koga (University of Southern California, Los Angeles. Engineering Center). Nov. 1961. Contract AF49(638)-831. (AFOSR-1870)

The distribution function of charged particles near a charged spherical body is calculated, assuming that at infinite distances the particles have a Maxwellian distribution and that the sphere is in motion relative to the particles at infinite distances from it. (auth)

9294 (AEC-tr-4962) SELF-TRAPPED ELECTRON AND THE ACOUSTICAL MODE LATTICE VIBRATION. Yutaka Toyosawa. Translated from Busseiron Kenkyu (2), 7: 123-41(1960). 18p.

The function of the acoustical mode lattice vibration in self-trapping of electrons is described. It is shown that in the acoustical mode lattice vibration, when the electron interaction constant goes beyond a certain limit, suddenly, the effective mass (absolute zero) becomes practically an infinite amount of trapped electrons. The narrow-band perturbation method, the case of the simple cubic lattice, activated condition, stability of trapped electrons, effective mass, jump frequency, and consideration of real material are discussed. (M.C.G.)

9295 (CEA-tr-R-1408) SPECTRES RAMAN DU H_2O ET DU D_2O A DIVERSES TEMPERATURES. (Raman Spectra of H_2O and D_2O at Various Temperatures). V. I. Val'kov and G. L. Maslenkova. Translated into French from Vestnik Leningrad. Univ., 12: No. 22, Ser. Fiz. i Khim. No. 4, 8-13(1957). 13p.

The Raman spectra of the O–H and O–D vibration bands in light and heavy ice are studied at 0 to −200°C, at frequencies of 1200 to 3600 cm^{-1}. These spectra are compared with those found for liquid H_2O and D_2O at 20°C. The spectra are excited by the 4047, 4078, and 4358 Å lines of Hg. (T.F.H.)

9296 (CEA-tr-R-1419) COCRISTALLISATION DE MICROIMPURETES AVEC DES CRISTAUX EN FORMATION. (Cocrystallization of Microimpurities with Crystals in Formation). I. V. Melikhov. Translated into French from Radiokhimiya, 2: 509-20(1960). 31p.

A theoretical study is presented of the coprecipitation of micro–impurities with macro-crystals, during the formation of these macro-crystals in supersaturated solutions. The principal effects studied are surface processes (e.g. the interaction of the micro-inclusion with the phase-boundary surface) and mass transfer processes in the solution. It is shown that both homogeneous and heterogeneous mechanisms are active in the distribution of the macro- and micro-constituents. The formation of NaCl crystals containing micro-quantities of $PbCl_2$, $CdCl_2$, and TlCl is discussed as an example. (T.F.H.)

9297 (FTD-TT-61-226) DIRECT CONVERSION OF THERMAL POWER TO ELECTRICAL POWER. N. D. Morgulis. Translated from Vestnik Akad. Nauk S.S.S.R., 31: No. 9, 25-31(1961). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 6872.

9298 (JPRS-10349) NEWS OF HIGHER EDUCATIONAL INSTITUTIONS, MINISTRY OF HIGHER EDUCATION, RADIO PHYSICS SERIES. Translation of Izvest. Vysshykh Ucheb. Zavedenii, Radiofiz., 4: No. 1, 1-198 (1961). 415p.

Twenty-two papers are included which treat various topics in radiophysics. A separate abstract was prepared for one paper dealing with the energy conservation law in electrodynamics; another paper was previously abstracted in NSA. The last paper is a report on a conference on radio electronics. (D.L.C.)

9299 (JPRS-10349(p.150-80)) THE ENERGY CONSERVATION LAW AND THE EXPRESSION FOR THE ENERGY DENSITY IN THE ELECTRODYNAMICS OF AN ABSORBING AND DISPERSIVE MEDIUM. V. L. Ginzburg. Translated from Izvest. Vysshykh Ucheb. Zavedenii, Radiofiz., 4: 74-89(1961).

The energy conservation law in electrodynamics is discussed as well as the expression for the energy density in an absorbing and dispersive medium. Phenomenological expressions are compared with the results obtained for plasma by means of the kinetic equation, and also the equation of motion for a mechanical model with friction losses. Propagation velocity of signals in an absorbing medium is discussed briefly. (auth)

9300 (UCRL-Trans-761(L)) ON THE EQUATION OF STATE AT HIGH TEMPERATURES AND DENSITIES. Helmut Steinwedel and J. Hans D. Jensen. Translated by S. G. Brush (Univ. of California Lawrence Radiation Lab., Livermore) from Z. Physik, 125: 394-404(1949). 11p.

The equation of state of matter is studied at temperatures on the order of 1 MeV and at densities below 10^{38} particles/cm^3. The equation obtained relates the tem-

perature, neutron density, and proton density (or proton-neutron ratio). The results are used to study the possibility of the existence of a frozen-in thermal equilibrium in this region. (T.F.H.)

9301 (UCRL-Trans-777(L)) ACTION OF SHOCK AND EXPLOSION IN DEFORMABLE MEDIA. (Deystvie Udara i Vzryva v Deformiruemykh Sredakh). G. I. Pokrovskii and I. S. Fedorov. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore) from a publication of the State Publisher of Literature on Construction Materials, Moscow, 1957. 413p.

A series of phenomena which occur during explosions are examined. The physical bases of explosion-induced actions in ground and rock are considered and a model for description of shock effects in ground, rock, and structural material is presented. Formulas for computing the various explosion parameters are presented and methods for preparation of models to describe shock and explosion are included. (J.R.D.)

9302 THE SPINOR SPACE AS AN EUCLIDEAN COMPLEX SPACE. Jerzy Lukierski (Univ. of Wrocław, Poland). Acta Phys. Polon., 20: 957-67(1961). (In English)

The equivalence between Rzewuski's spinor space and 4-dimensional Euclidean complex space is proved. The free field equation in spinor space is solved by the procedure of analytical continuation. The field equation with sources is investigated using the complex distribution $\delta(z)$. (auth)

9303 SPECIFIC HEAT OF A PARTICLE IN A BOX. Herbert B. Rosenstock (Naval Research Lab., Washington, D. C.). Am. J. Phys., 30: 38-40(Jan. 1962).

The specific heat of a free particle of mass m in a cubic box of dimensions L with reflecting walls is found to be a function of variable $\eta = 2mL^2kT/h^2$. For large η, the specific heat approaches the classical equipartition value dk/2 (d = dimensionality), for small η it approaches zero as $T^{-2}\exp(-\text{const}\ T^{-1})$, and in between, at $\eta = 9\pi$, it has a maximum, (9/8)(dk/2). (auth)

9304 SOLUTION OF A COMBINATORIAL PROBLEM. INTERMEDIATE STATISTICS. Michael E. Fisher (King's Coll., London). Am. J. Phys., 30: 49-51(Jan. 1962).

The mathematical technique of "generating functions" is described, and illustrated by solving the problem: "How many ways are there of distributing m identical marbles between n numbered boxes when no box may hold more than M marbles?" This problem includes both Bose-Einstein and Fermi-Dirac statistics. (auth)

9305 BOMBARDMENT INDUCED RE-EMISSION OF IONICALLY PUMPED INERT GAS FROM A GLASS SURFACE. L. H. James and G. Carter (Univ. of Liverpool). Brit. J. Appl. Phys., 13: 2-8(Jan. 1962).

Studies were made of the release of an inert gas, argon or krypton, ionically pumped into glass surfaces, by subsequent bombardment with the other gas, krypton or argon. It is found that ion bombardment, up to energies of 1 kev, cannot completely recover sorbed gas. This, and other evidence, leads to the conclusion that gas is released, during ion bombardment, by transfer of sufficient energy to a trapped gas atom, for its desorption, rather than simultaneous release during glass sputtering. Approximate values for gas sputtering coefficients are deduced. It is also concluded that gas is held in superficial trapping sites rather than in a depth distribution into the solid. (auth)

9306 DIRECT CONVERSION OF THERMAL ENERGY INTO ELECTRIC ENERGY BY MEANS OF THERMOEMISSION. E. Tomková (Charles Univ., Prague). Československ. časopis pro fysiku, A 11: 516-34(1961). (In Czech).

A survey of methods of direct conversion of thermal into electric energy using the thermoemission current of a diode is given, both from the theoretical and the experimental aspect. The efficiency of the diode is increased by eliminating the minimum of the electrostatic potential formed by the space charge of electrons in the diode. Two methods are given: the compensation of the space charge of the electrons by the charge of positive ions of cesium and the decrease of the distance between the electrodes of the diode. (auth)

9307 THERMIONIC CURRENT TRANSMISSION IN A STRONG MAGNETIC FIELD. Alfred Schock and Charles L. Eisen (Republic Aviation Corp., Farmingdale, N. Y.). J. Appl. Phys., 33: 1-2(Jan. 1962).

In an earlier analysis of the effect of magnetic fields on thermionic diodes (A. Schock, J. Appl. Phys., 31: 1978 (1960)), numerical results indicated that under certain conditions the fraction of emitted electrons reaching the collector equals the sine of the angle at which the magnetic field intersects the emitting surface. An analytic proof of this relation is presented. (auth)

9308 MAGNETIC SHIELDING BY SUPERCONDUCTING FILMS. R. J. Oakes (Minneapolis-Honeywell Regulator Co., Minneapolis). J. Appl. Phys., 177-9(Jan. 1962).

The magnetic field distribution and supercurrent density are calculated exactly using the Maxwell-London equations for the case of an ideal superconducting spherical shell immersed in a steady uniform magnetic field. It is shown that the magnetic field is strongly attenuated by the spherical shell even if the shell thickness is as small as 1000 A. (auth)

9309 CLEANUP RATES OF TRACE AMOUNTS OF RADIOACTIVE KRYPTON IN VARIOUS NOBLE GAS DISCHARGES. C. Y. Bartholomew (Bell Telephone Labs., Inc., Allentown, Penna.), G. Cassidy, and A. R. LaPadula. J. Appl. Phys., 33: 230-1(Jan. 1962).

Cleanup of Kr^{85} in gas discharge tubes in which the isotope is present in trace amounts in Ar, Ne, or Kr is discussed. The tubes were operated at 40 ma d-c and 100 v, and after suitable intervals of operation, the Kr^{85} cleanup was measured. A well-type scintillation counter was used for monitoring. For Ar or Ne as the carrier gas, the Kr^{85} cleanup approaches an appreciable saturation value; for Kr, the value is much smaller. It is suggested that when Kr^{85} is cleaned up in the presence of a carrier gas, it must compete with carrier gas atoms for sites on and in the cathode surface layer. (L.N.N.)

9310 ELECTRON PROBE INTENSITY CALCULATIONS FOR 20-50 Kev ELECTRONS. L. S. Birks (U. S. Naval Research Lab., Washington, D. C.). J. Appl. Phys., 33: 233(Jan. 1962).

A means for using electron range data to establish electron excitation curves, $\phi(\rho x)$, for a range of electron energies is presented. Experimental measurements of $\phi(\rho x)$ become unnecessary. Curves are prepared and accuracies are tested using 25 measurements each on NiKα and CrKα in a 78% Ni–20% Cr alloy. No systematic errors are found. (L.N.N.)

9311 AN INTRODUCTION TO RADIOACTIVITY. T. H. Y. Tebbutt. J. Proc. Inst. Sewage Purif., Pt. 3, 179-90(1961).

Basic information is presented which enables proper understanding of the many problems associated with radioactivity. Following a brief introduction into nuclear physics,

the main types of radiation are discussed and the penetrating powers of the different types are compared. Half-life, specific activity, and relative biological effectiveness of specific isotopes and radiation types are covered, and from this information, the establishment of drinking water standards and permissible levels of radiation are explained. Radiation detection theory and instrumentation is presented with illustration of the operational behavior of the Geiger-Muller, internal proportional, and scintillation counters that measure the incident radiation. With this background, the subject of waste disposal is discussed after a classification of radioactive wastes according to their activity level. 6 tables. 5 figures. 18 references. (Journ. and Proc. of the Instit. of Sewage Purif.)

9312 ENERGY TO FORM AND TO MOVE VACANT LATTICE SITES IN GRAPHITE. C. Baker and A. Kelly (Cambridge Univ., Eng.). Nature, 193: 235-6 (Jan. 20, 1962).

Experiments indicated that the energy necessary to form vacancies in quenched graphite single crystals is 2.4 to 4.2 ev. The activation energy to move a vacancy was estimated to be 2.6 to 3.7 ev. If diffusion occurs by a vacancy mechanism the activation energy for self-diffusion should be given by the sum of these two energies or be 6.45 ± 1.45 ev. From the time and temperature necessary to anneal out the dislocation loops, an independent estimate was made of the activation energy for self-diffusion assuming a vacancy mechanism. This gave a value of 6.3 ev which is consistent with the value obtained from the sum of the energies for vacancy formation and moving. (M.C.G.)

9313 ENERGY DISTRIBUTIONS OF PHOTOELECTRONS FROM METALS DUE TO A SURFACE EFFECT. John W. Dewdney (Darthouth Coll., Hanover, N. H.). Phys. Rev., 125: 399-404 (Jan. 15, 1962).

Expressions are derived for the distribution in total energy of photoelectrons from a metal on the basis of the alternative assumptions concerning the photon absorption process. The calculations are exact, avoiding the approximation that the frequency of the incident light must be near the threshold frequency. Expressions are given for the distribution in energy of electrons emitted in all directions and for the energy distribution as a function of the emission angle. (auth)

9314 DRIVEN CLASSICAL SYSTEM AND CHARACTERISTIC FUNCTIONS. S. Teitler (U. S. Naval Research Lab., Washington, D. C.). Phys. Rev., 125: 405-8 (Jan. 15, 1962).

A general dynamical equation of motion for the characteristic function associated with the phase density is derived from the Liouville equation. A similar procedure is applied to the linearized Liouville equation for a driven classical system. A general equation for the dynamical motion of the perturbed part of the characteristic function is obtained in which driving and relaxing terms are explicitly considered. This formalism is applied to the calculation of the electrical conductivity of a dilute gas of free, charged particles under the influence of a steady electric field and interacting with randomly distributed fixed scatterers. (auth)

9315 KINETICS OF VACANCY-INTERSTITIAL ANNIHILATION. I. IMPURITY-INTERSTITIAL TRAPPING. A. C. Damask and F. J. Dienes (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 125: 444-6 (Jan. 15, 1962). (BNL-5596)

The equations for the kinetics of vacancy-interstitial annihilation with interstitial trapping at impurities are solved in closed form. Although the transients are given by complex combinations of exponentials, the latter part of the decay is simple quadratic. This quadratic decay is governed by the decomposition of the interstitial-impurity complex. The effective activation energy is the sum of the interstitial migration energy and its binding energy to the impurity. (auth)

9316 KINETICS OF VACANCY-INTERSTITIAL ANNIHILATION. II. DI-INTERSTITIAL FORMATION. G. J. Dienes and A. C. Damask (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 125: 447-50 (Jan. 15, 1962). (BNL-5630)

Equations for the kinetics of vacancy-interstitial annihilation with di-interstitial formation were solved on an analog computer. At low temperature, or for high di-interstitial binding energy, the decomposition reaction can be neglected. Analytic approximations were found and shown to be valid in this case. Conventional methods of activation energy determination are valid in this region for evaluating the interstitial migration energy. At high temperature, or for low binding energy, the di-interstitial concentration may be neglected and the resulting kinetics is the simple quadratic interstitial-vacancy annihilation governed by the interstitial migration energy. In the intermediate region, no analytic approximations were found and the rate constants, therefore, cannot be evaluated. (auth)

9317 INTERNAL FIELDS AT LOW TEMPERATURES IN CoPd ALLOYS. D. E. Nagle, P. P. Craig, P. Barrett, D. R. F. Cochran, C. E. Olsen, and R. D. Taylor (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 125: 490-1 (Jan. 15, 1962).

The hyperfine splitting of the 14.4-kev gamma line in Fe^{57} was measured for a series of sources, each containing Co^{57} activity doped into a host lattice of CoPd. Although Pd itself is not ferromagnetic, the alloys with Co are all ferromagnetic, with Curie temperatures ranging from 1404°K for pure Co down to 130°K for a 3% Co alloy. The internal field associated with the hyperfine splitting is a function of temperature for a given alloy; however, at temperatures small compared to the Curie temperature, each source shows very nearly the same internal field, namely −308 kgauss. The relationship of this behavior to current theories of the internal field in Fe and to the nature of ferromagnetism in CoPd is discussed. (auth)

9318 PARTICLE-HOLE INVERSION IN THE FERMI SURFACE: A SYMMETRY OPERATION FOR COLLECTIVE EXCITATIONS. J. C. Fisher (General Electric Research Lab., Schenectady, N. Y.). Phys. Rev., 125: 492-4 (Jan. 15, 1962).

The operation of transposing particles (or holes) on one side of a Fermi surface into holes (or particles) on the other side is shown to be a symmetry operation of the Bardeen, Cooper, and Schrieffer reduced Hamiltonian and an approximate symmetry operation of the full two-particle scalar interaction Hamiltonian, insofar as particle-conserving collective excitations are concerned. Calling this operation *f* inversion, and the conserved quantity associated with it *f* parity, the zero-rest-energy collective excitations in a Fermi gas with weak attractive interactions have *f* parity = −1. (auth)

9319 QUANTIZATION AND STABILITY OF CURRENTS IN SUPERCONDUCTORS. A. Bohr (Univ. of Copenhagen) and B. R. Mottelson. Phys. Rev., 125: 495-9 (Jan. 15, 1962).

In an electron gas with pairing correlations there exists the possibility of excited states corresponding to a modified

pairing of the electrons and associated with "supercurrents." The quantization of these states, which is also reflected in the quantization of flux through a multiply connected superconductor, implies the occurrence of macroscopic "isomerism" providing an immediate explanation of the persistent currents. It is suggested that similar phenomena, associated with vortex lines in the electron fluid, may occur in simply connected samples under suitable conditions. (auth)

9320 OPTICAL ABSORPTION AND ELECTRON SPIN RESONANCE AFTER OPTICAL AND THERMAL BLEACHING OF F CENTERS. W. E. Bron (IBM Research Center, Yorktown Heights, N. Y.). Phys. Rev., 125: 509-13 (Jan. 15, 1962).

A correlation is observed between changes in the half-width and peak position of the F band and the presence of M and R centers in x-irradiated KCl crystals. The changes in the shape of the F band caused by optical bleaching are attributed to absorption bands of M and R centers located in the spectral region of the F band. The narrowing of the electron spin resonance line which occurs during optical bleaching of x-irradiated KCl crystals is removed by thermal treatment at 140°C. The narrowing is tentatively attributed to the presence of a second, narrow resonance line, due to either R_3 or N centers, which is superimposed on the line attributed to F centers. The results also suggest that M, R, and V_3 centers are not paramagnetic. Both the optical absorption and the electron spin resonance measurements indicate that F centers are present even after prolonged optical bleaching and that the character of the F center is not changed during bleaching. (auth)

9321 EFFECTS OF VIRTUAL EXCITATION OF THE 2s STATE ON THE ELASTIC SCATTERING OF ELECTRONS BY ATOMIC HYDROGEN. Kenneth Smith (Argonne National Lab., Ill.), Robert P. McEachran, and Peter A. Fraser. Phys. Rev., 125: 553-8 (Jan. 15, 1962).

The elastic scattering of electrons by hydrogen atoms, for electron energies below the first threshold of excitation of the atom (10.2 ev), is investigated numerically making full allowance for exchange and for the virtual excitation of the 2s state. Singlet and triplet phases for the s, p, and d partial waves were obtained. While the calculation is essentially preliminary to a more extensive eigenfunction expansion calculation for this problem, which would allow for nonspherical distortion of the atom, significant changes from the first exchange approximation may be expected as more states are included in the expansion. In particular, just below the n = 2 excitation threshold the singlet s phase and the triplet p phases begin to increase sharply, and what may be a Wigner cusp shows in the total cross section. Predicted angular distributions are compared with the recent measurements of Gilbody, Stebbings, and Fite. The phase shifts are compared with those of the exchange approximation, and also with those of Geltman, who performed a variational calculation allowing for the virtual excitation of the 2s and 3s states. (auth)

9322 DEPENDENCE OF INDUCTION AND DISPERSION ENERGIES AT FINITE INTERNUCLEAR DISTANCES. Louis Chopin Cusachs (Centre de Mécanique Ondulatoire Appliquée Paris). Phys. Rev., 125: 561-6 (Jan. 15, 1962).

The usual calculations of induction and dispersion energies lead to divergent series in negative powers of the distance R which are interpreted as asymptotic expansions. The system composed of a normal hydrogen and a proton at a finite separation is treated by an extended variation method, leading to Euler equations for the perturbed wave functions. Solutions in terms of known functions are used to calculate the two principal terms of the second-order energy for a number of values of R. The method leads to convergent results for all values of R, and is compatible with the virial theorem. Extension to more complex cases and to dispersion is qualitative. A variation calculation, using traditional and other plausible trial functions with the correct potential, is compared. The series in negative powers of R are neither quantitatively nor qualitatively good representations of induction effects at chemically interesting distances. Similar behavior is inferred for dispersion. (auth)

9323 RESONANT ELECTRON CAPTURE IN VIOLENT PROTON-HYDROGEN ATOM COLLISIONS. Grant J. Lockwood and Edgar Everhart (Univ. of Connecticut, Storrs). Phys. Rev., 125: 567-72 (Jan. 15, 1962).

A new collision chamber design makes possible differential measurements of protons scattering on atomic hydrogen target atoms. The scattering takes place in the interior of a furnace where hydrogen gas is dissociated. Electron capture probability is measured vs proton energy for protons passing nearly through the center of isolated hydrogen atoms such that the incident particle is scattered through an angle of 3°. This shows a resonant structure with maxima at energies of 0.78, 1.57, 3.92, and 20.1 kev. A simple model is presented for looking at these resonances. In the light of this model and previous theoretical work, the location of the high-energy maximum is unexpectedly low, and this suggests that a phase constant is needed to achieve agreement between experiment and theory. The H^+ on H data presented here are compared with those for the other combinations, H^+ on H_2, H^+ on He, and He^+ on He, which also show resonant electron capture. (auth)

9324 STRONG ELECTRIC FIELD EXPERIMENTS ON POSITRONIUM IN GASES. Felix E. Obenshain and Lorne A. Page (Univ. of Pittsburgh). Phys. Rev., 125: 573-81 (Jan. 15, 1962).

The increase in positronium formation on applying a d-c electric field is measured using a two-photon angular correlation method as well as pulse-height analysis. In argon and in nitrogen, the field dependence at pressures ranging up to 28 atmospheres is consistent with results of other investigators. In oxygen, an increase by a factor of 2 is demonstrated, the field and pressure dependence having the same characteristics as for argon and nitrogen. In sulfur hexafluoride this normal increase in positronium formation is produced, requiring for given density an order of magnitude higher fields than in these other gases; also, the main features of an abnormal decrease in formation with increasing field occuring at comparatively low fields are determined. A certain range-energy systematic effect crucial to field reversal experiments is explored empirically, and it is concluded that the $\sigma \cdot E$ effect for positronium can be traced in large part to this effect. (auth)

9325 ELECTRON IMPACT IONIZATION OF ATOMIC HYDROGEN AND ATOMIC OXYGEN. Erhard W. Rothe, Lawrence L. Marino, R. H. Neynaber, and S. M. Trujillo (General Dynamics/Astronautics, San Diego, Calif.). Phys. Rev., 125: 582-3 (Jan. 15, 1962).

Total cross sections for the ionization of atomic oxygen and atomic hydrogen were measured by a modulated molecular beam technique. The impact energies were 100 to 500 ev for oxygen and 100 to 750 ev for hydrogen. The number of ions formed in a region defined by the intersection of an electron beam and a modulated molecular

beam was compared with the number formed when the neutral beam was partially dissociated. All ions were collected, including those energetic ions formed in dissociative ionization. The degree of dissociation was measured with a mass spectrometer. From the data, the ratios of the atomic to the molecular ionization cross sections were obtained. The absolute atomic values were calculated by multiplying these ratios by the molecular ionization cross sections. Results are compared with theoretical estimates and experimental determinations. (auth)

9326 LOW-LYING LEVELS IN CERTAIN ACTINIDE ATOMS. B. R. Judd (Univ. of California, Berkeley). Phys. Rev., 125: 613-25(Jan. 15, 1962). (UCRL-9779)

Calculating the ordering and properties of low-lying levels in configurations of the type $5f^n6d$ falls into (a) the choice of a coupling scheme to define the basic eigenfunctions; (b) the evaluation of the matrix elements of the spin-orbit interaction and of the Coulomb interaction in the form of linear combinations of certain radial integrals; (c) the estimation of the radial integrals; (d) the diagonalization of the energy matrices. With regard to (a), the J_j coupling scheme is considered to be the most appropriate; this implies that the Coulomb interaction between the core, comprising the equivalent f electrons, and the d electron (to whose levels the respective symbols J and j refer) is weak compared with the interactions within the two systems. Part (b) is carried out by applying the tensor operator and group theoretical methods of Racah. For (c), values of the integrals F_k (5f,6d) and G_k (5f,6d) are estimated by assuming that they maintain the ratios one to another as they do in Th_{III}, and that their variation along the actinide series parallels the variation of $G^3(5f,7_s)$. The last parameter is known for Th_{III}, and analyses of U_{II}, Pu_{II}, and Am_{II} show that it decreases, advancing along the actinide series. This decline is interpreted as being due to the collapse of the 5f shell, and the internal nature of the 5f electrons allows general statements to be made about the spin-orbit coupling constants. Additional information on the parameters is provided by an analysis of the properties of the four lowest levels of Cm_I. Part (d) is accomplished for the lowest levels of f^2d, f^3d, f^4d, f^6d, and $f^{10}d$ by neglecting all off-diagonal elements; for U_I f^3d, where extensive spectroscopic information is available, the interaction of the levels deriving from the J_j coupling of $^4I_{9/2}$ to $^2D_{5/2}$ with those deriving from the coupling of $^4I_{9/2}$ to $^2D_{3/2}$ is included. Where experimental data are available, agreement with the theory is good. (auth)

9327 TRANSITION RADIATION FROM METAL FILMS. Edward A. Stern (Univ. of Maryland, College Park). Phys. Rev. Letters, 8: 7-10(Jan. 1, 1962).

It is shown that R. A. Ferrell's calculation of a peak of radiation at the plasma frequency from thin films (Phys. Rev. 111: 1214 (1958)), while valid, can also be obtained from a calculation of transition radiation (V. P. Silin and E. P. Fetisov, Phys. Rev. Letters 7: 374 (1961)). (L.N.N.)

9328 A PRELIMINARY STUDY OF THERMOLUMINESCENT DOSIMETRY. Stanley J. Malsky, Charles G. Amato, Bernard Roswit, Cyprian B. Reid, and Charles Spreckels (Veterans Administration Hospital, Bronx, N. Y.). Radiology, 78: 277(Feb. 1962).

A miniature solid state dosimeter based on the phenomenon of thermoluminescence is being investigated for introduction into an in vivo dosimetry system. The radiation-sensitive element is a manganese-activated calcium fluoride phosphor. The dosimeter is in the form of a needle, 10 mm. long and less than 1 mm. in outside diameter. It is sealed in a glass tube and read by heating at a constant rate. The range is estimated to be from 10^{-5} to 10^5 r. (M.C.G.)

9329 THE FUNDAMENTALS OF X-RAY AND RADIUM PHYSICS. Third Edition. Joseph Selman. Springfield, Illinois, Charles C. Thomas, 1961. 378p.

After a review of basic physics (mechanics, electrostatics, electromagnetics, x rays, and atomic theory) and electronics (electric currents, electric motors and generators, high-voltage sources, and rectifiers), a study is made of x ray and radium technology. X ray tubes (roentgenographic tubes, therapy tubes, and valve tubes) and circuits are examined. Attention is devoted to x ray film, film handling and developing, darkroom specifications, and the chemical aspects of film processing. Factors influencing radiographic quality are detailed. Specialized x ray techniques are outlined. The nuclear properties and medical uses of Ra are investigated. Safety aspects of radiological operations are discussed. (T.F.H.)

9330 STATISTICAL INFERENCE FOR MARKOV PROCESSES. Patrick Billingsley. Statistical Research Monographs. Volume II. Chicago, University of Chicago Press, 1961. 78p.

For Markov processes having a time parameter that can only assume discrete values, there exist stationary transition measures that depend on an unknown parameter θ. Methods are developed for finding the properties of θ. The results constitute a large-sample theory, based on the likelihood function. The results are applicable to autoregressive problems and problems involving countable chains, as well as to finite Markov processes. The analogous problems for a Markov process with a continuous time parameter are also considered. Only completely discontinuous processes are considered, and it is shown that for these processes the problem reduces to the discrete-time-parameter problem. (T.F.H.)

9331 ELEKTROMAGNITNYE SVOISTVA PLAZMY I PLAZMOPODOBNYKH SRED. (Electromagnetic Properties of Plasma and Plasmic Media). V. P. Silin and A. A. Rukhadze. Moscow, Gosatomizdat, 1961. 281p.

The theoretical aspects of dielectric penetrability spatial dispersion are analyzed, and isotropic and anisotropic plasma properties are discussed. The influence of spatial dispersion on metal and dielectric penetrability is also discussed. 300 references are included. (R.V.J.)

9332 QUALITATIVE METHODS IN THE MANY BODY PROBLEM. G. F. Khilmi. Russian Tracts on Advanced Mathematics and Physics. Volume III. New York, Gordon and Breach Science Publishers, Inc., 1961. 126p. $6.50. Translated by B. D. Seckler from "Kachestvenniye Metody V Probleme n Tyel." Moscow, Publishing House of the Academy of Sciences, 1958.

Equations and general integrals of the n-body problem are given, and Jacobi theorems on the final motion are presented. The preliminary method of dimensional analysis is applied; means of application are considered. Effective qualitative results are obtained by applying the method of continuous induction. Sufficient conditions for the occurrence of types of final motions in the form of conditions on the initial state of the dynamic system are formulated. Application of the method of invariant measure necessitates formulation of theorems on dynamic-system measure theory. General theorems on gravitating-body-system motion are proved using this method. Cases of evolution of systems of n gravitating bodies are analyzed on the basis of celestial mechanics. (L.N.N.)

Astrophysics and Cosmology

9333 (FTD-TT-61-314) HYPERON STARS. G. S. Saakyan. Translated from Priroda, 49: No. 11, 14-21 (1960). 19p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 9636.

9334 EMISSION SPECTRUM OF CALIFORNIUM. John G. Conway (Univ. of California, Berkeley), E. Kenneth Hulet, and Richard J. Morrow. J. Opt. Soc. Am., 52: 222 (Feb. 1962). (UCRL-9776)

The measured emission spectrum of Cf was compared with observations of the supernovas IC4182 and NGC1003. No similarities were found. Wavelengths and relative intensities of the Cf line are presented in tabular form. (L.N.N.)

9335 SCIENCE IN SPACE. GALACTIC AND EXTRA-GALACTIC ASTRONOMY. Chapter VIII of a Report in Progress by the Space Science Board. (National Research Council. Space Science Board). 1960. 53p.

Ways in which satellite investigations will advance the cause of astronomy are discussed. The problems of current interest in astronomy and astrophysics that may be investigated by space techniques include stellar populations and evolution, the abundances of the elements, stellar radiation, discrete emission-line gaseous nebulae, the interstellar medium, galaxies, and sources of radio-frequency radiation. Problems that may be investigated by short-wavelength photometry and spectroscopy, infrared investigations, radio-frequency studies, and high-resolution astrometry are also discussed. (N.W.R.)

Cosmic Radiation

Refer also to abstract 9017

9336 (CRGP-1056) REVIEW OF RECENT HIGH ENERGY SOLAR PARTICLE EVENTS INCLUDING NOVEMBER 1960. H. Carmichael and J. F. Steljes (Atomic Energy of Canada Ltd. Deep River Lab., Ont.). Oct. 30, 1961. 31p. (AECL-1387)

Presented at Plenary Session on Solar Radiation Particles, Kyoto Conference on Cosmic Radiation and Earth Storm, September 8, 1961.

The eight cosmic-ray increases caused by high energy particles from the sun that have been observed during the years 1959, 1960, and 1961 are illustrated, and some of the ideas discussed at the Kyoto Conference on Cosmic Radiation and Earth Storm, regarding the propagation and storage of the particles in interplanetary space, are outlined. (auth)

9337 (NASA-TN-D-1010) STATISTICS OF SOLAR COSMIC RAYS AS INFERRED FROM CORRELATION WITH INTENSE GEOMAGNETIC STORMS. David Adamson and Robert E. Davidson (National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.). Feb. 1962. 24p.

A statistical study revealed that solar cosmic rays occur in a nonrandom fashion in the proximity of the earth. These solar cosmic ray events show a tendency to occur in sequences and to occur more frequently in spring and fall. The results are inferred from data pertaining to geomagnetic storms having intensities exceeding a certain threshold. This threshold was chosen to provide the best correlation with direct indicators of solar cosmic rays such as riometry and high-altitude balloon measurements. The desirability of using geomagnetic data for statistical analysis lies, of course, in such data being available over many years. (auth)

9338 (NP-11237) ANGULAR DISTRIBUTION OF JETS PRODUCED BY HEAVY PRIMARY COSMIC RAY NUCLEI. E. Balea, E. Friedlaender, C. Potoceanu, and M. Sahini (Academia R. P. R. Institutul de Fizica Atomica, Bucharest). 1961. 30p.

A study was made of the angular distribution characteristics for jets induced by heavy primary nuclei. A method was developed for the detection and elimination of evaporation jets from the induced jets, which was used to show that in some cases the angular distributions of secondaries from interactions of high-energy heavy primary nuclei with photographic emulsion nuclei, have a polymodal shape, consistent with that observed in interactions produced by particles of unit charge. The preliminary results obtained for true bimodal jets are considered in qualitative agreement with previous results for nucleon-nucleon collisions. (B.O.G.)

9339 (SUI-61-16) OBSERVATION OF GALACTIC AND SOLAR COSMIC RAYS FROM OCTOBER 13, 1959 TO FEBRUARY 17, 1961 WITH EXPLORER VII (SATELLITE 1959 IOTA) (thesis). Wei Ching Lin (Iowa. State Univ., Iowa City). Aug. 1961. 100p.

A summary is presented of cosmic-ray intensity observations at high latitudes in the altitude range 550 to 1100 km by means of Geiger tubes in Explorer VII. The time period covered is October 13, 1959 to February 17, 1961. Of special interest are the data on some 20 solar cosmic-ray events, including major events of early April 1960, early September 1960, and mid-November 1960. (auth)

9340 INTENSITY-TIME VARIATIONS OF THE COSMIC RADIATION. J. A. Lockwood (Univ. of New Hampshire, Durham). Am. J. Phys., 30: 10-15(Jan. 1962).

Both the energy spectrum and total intensity of cosmic particles arriving at the earth change with time. A survey is presented of the major changes in the flux of relativistic particles, with representative data from nucleonic detectors. The rigidity dependence and attenuation for the long-term change and transient variations are discussed. Some data for the sudden increases that represent solar injection are shown. These intensity-time variations yield information about the electromagnetic state of the earth-sun region. (auth)

9341 NUCLEATION BY COSMIC RAYS IN ULTRASONIC CAVITATION. D. Sette and F. Wanderlingh (Università, Messina, Italy and Ultracoustics Institute "O. M. Corbino," Rome). Phys. Rev., 125: 409-17 (Jan. 15, 1962).

Nucleation in ultrasonic cavitation is due to cosmic rays. The neutron component seems sufficient to explain the experiment in water, through the creation of oxygen recoil nuclei which would act as nucleating agents; energy deposit and radiolytic effects produce small overheated and oversaturated regions in which cavities of radius larger than the critical one may originate. The microcavities would be created in the absence of a sound field and grow to visible size when an adequate sound field is applied. Enclosing the tank in which the liquid is contained with lead or paraffin screens results in threshold variations due to absorption and slowing down of primary neutrons and, probably, to nuclear reactions induced by the gamma and meson components of cosmic radiation in the screen material through the production of secondary neutrons. (auth)

9342 ISOTOPIC ABUNDANCE OF CARBON IN PRIMARY COSMIC RAYS. Hiroichi Hasegawa (Gakushuin Univ., Tokyo) and Kensai Ito. Progr. Theoret. Phys. (Kyoto), 26: 418-20(Sept. 1961). (In English)

A method for obtaining the C^{13}/C^{12} ratio in primary cosmic radiation is described. Cross sections for relative neutron-decay events are calculated and actual events in samples are measured. (L.N.N.)

9343 SCIENCE IN SPACE. PHYSICS OF FIELDS AND ENERGETIC PARTICLES IN SPACE. Chapter VII of a Report in Progress by the Space Science Board. (National Research Council. Space Science Board). 1960. 62p.

The current fundamental problems in the physics of energetic particles and fields in space, which may be open to attack through investigations outside our atmosphere, are discussed. Information is presented on what is known about the interplanetary medium, solar atmosphere, and interaction of these regions with the geomagnetic field. Attention is devoted mainly to atomic matter in space, ionization, and motion; to magnetic electric fields in space; and to the energetic particles, their origins, and acceleration processes. Other than for questions concerned with geomagnetic storms and the trapping and motion of particles in the geomagnetic field, no discussion is included on the immediate region about the Earth. Several experiments and observations are discussed that take advantage of the recent technical advances in rocketry, satellites, and space probes. (N.W.R.)

Criticality Studies

9344 (ANL-6378) CRITICAL EXPERIMENTS WITH THORIA–URANIA FUEL IN HEAVY WATER. W. C. Redman, S. G. Kaufmann, K. E. Plumlee, and Q. L. Baird (Argonne National Lab., Ill.). Dec. 1961. Contract W-31-109-Eng-38. 126p.

The nuclear characteristics of a variety of small reactors composed of thoria–urania fuel in heavy water were determined in a program of critical experimentation. The fuel element consisted of ceramic $ThO_2-U^{235}O_2$ pellets stacked to a height of 1.5 m within 0.787-cm-OD aluminum tubing. The pellets used most frequently were of 0.587-cm diameter and had a Th/U^{235} atom ratio of 25. Rods containing similar pellets with only half as much U^{235} were used to achieve small changes in the U^{235} content of the cores. Some cores were assembled with 0.660-cm-diameter pellets having an atom ratio of 15. All cores were located in a 2-m-diameter tank containing D_2O. Three distinct core structures were used, allowing measurements with uniformly distributed fuel rods, loading patterns compatible with the EBWR core geometry, and clustered lattic arrangements with D_2O, H_2O, and air surrounding the clustered fuel. Most of the cores assembled had some amount of radial D_2O reflector. A 0.3-m-thick bottom reflector composed of D_2O and aluminum was always present. For most of the assemblies, the control rods were fully withdrawn, criticality being achieved by adjustment of the water level. Observed critical dimensions and the results of the conventional reactivity, foil activation, and fuel substitution experiments used to determine core parameters such as p, ϵ, f, and τ, are reported. Information on void and temperature coefficients and control rod worth is included. No comparison of the experimental results with theoretical predictions is made nor are observations made on flux-trap systems of this composition included. (auth)

9345 (GA-2471) DEVELOPMENT OF MULTIPLYING ASSEMBLY. Final Report. J. C. Young, J. R. Beyster, P. R. Heid, D. H. Houston, and G. D. Trimble (General Atomic Div. General Dynamics Corp., San Diego, Calif.). June 30, 1961. Contract AT(04-3)-167. 74p.

A water-moderated multiplying assembly was designed, constructed, and pulsed with a high-intensity neutron source produced by an electron linear accelerator. Neutron die-away measurements made during the loading operations were correlated with the reactivity of the bare assembly. Neutron-spectra measurements were performed at the final loading. (auth)

9346 (HW-69525) MATERIAL BUCKLING MEASUREMENTS ON GRAPHITE–URANIUM SYSTEMS AT HANFORD: A SUMMARY TABULATION. D. E. Wood (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 1961. Contract AT(45-1)-1350. 99p.

Measurements of material bucklings for graphite–uranium systems are summarized. A comprehensive listing and guide to the original data sources is provided. Complete information on physical and nuclear properties of the lattice and the geometry of the exponential assembly is included, along with some of the auxiliary data taken. The fuel sizes vary from 0.925 to 2.5 in. in diameter for five different fuel geometries. The lattice spacings vary from $4^3/_{16}$ to 15 in. Over 300 measurements of material buckling are included. (auth)

9347 (JÜL-26-RE) UNTERKRITISCHE VERSUCHE FÜR DEN FRJ-1 (MERLIN-JÜLICH). (Subcritical Tests on FRJ-1 (Merlin-Jülich)). J. Jacquemin, H. Friedewold, and W. M. Cooper (Kernforschungsanlage, Jülich, Germany). Nov. 1961. 94p.

Subcritical tests were carried out for the FRJ-1 (Merlin-Jülich) in England. The critical mass was determined for the following nuclear arrangement: compact core; square, elongated, and U-shaped core; as well as a core with central air and water voids. For one series of core configurations, the efficiency of the coarse and fine control elements was determined. Further measurements referred to the determination of the temperature coefficients of the core and reflector, as well as to the distribution of the statistical weight and the void coefficients of reactivity in the compact core. The results of the measurements are given in tabular form. (tr-auth)

9348 (NAA-SR-Memo-5205(Rev.)) REVISION OF NEUTRON LIFETIME CALCULATIONS OF KEWB "A" CORE. J. M. Zetterbaum (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 20, 1960. Contract [AT(11-1)-Gen-8]. 8p.

The neutron lifetime of the KEWB "A" core was recalculated to be 2.18×10^{-5} sec for the full core and 1.41×10^{-5} sec for the underfull core. The reflector was ignored. (D.L.C.)

9349 (RFP-248) INDUSTRIAL CRITICALITY MEASUREMENTS ON ENRICHED URANIUM AND PLUTONIUM. PART II. C. L. Schuske, C. L. Bell, G. H. Bidinger, and D. F. Smith (Dow Chemical Co. Rocky Flats Plant, Denver). Jan. 10, 1962. Contract AT(29-1)-1106. 20p.

A series of neutron multiplication measurements made on sub-critical systems containing enriched uranium and plutonium is presented. These measurements involve both aqueous and metal systems. (auth)

9350 (AEC-tr-4712) CRITICAL MASSES OF AQUEOUS MIXTURES OF URANIUM AND PLUTONIUM COM-

POUNDS. A translation of "Kriticheskie Massy Vodnykh Smesei Soedinenii Urana i Plutoniya." G. Marchuk, G. A. Ilyasova, V. E. Kolesov, V. P. Kochergin, L. P. Kuznetsova, and E. I. Pogudalina (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 24p.

Calculations were made of critical masses of spherical reactors with hydrogen-containing moderators. A method is proposed which takes into account the features of the slowing down of neutrons by hydrogen nuclei. It is based on the diffusion approximation. The procedure described takes into account both elastic and inelastic scattering of neutrons at energies above thermal, and also the thermalization of neutrons in the region of thermal-motion energies. Results are given of the calculations of critical masses of reactors with and without reflectors, in which the active zone consists of mixtures of UO_2 and $UO_2 + PuO_2$ with water. (auth)

9351 (AEC-tr-4713) CRITICAL MASSES OF URANIUM–BERYLLIUM REACTORS. A translation of "Kriticheskie Massy Uran-Berillievykh Reaktorov." G. I. Marchuk, G. A. Ilyasova, V. E. Kolesov, V. P. Kochergin, L. I. Kuznetsova, and E. I. Pogudalina (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 10p.

Calculations were made of critical masses of U–Be reactors without reflectors, as well as with infinite beryllium reflectors at different degrees of enrichment of the uranium. All calculations were carried out in the diffusion-age approximation and by the many-group method. Results are presented in graph form. (M.C.G.)

9352 (AEC-tr-4714) APPROXIMATE METHOD OF CALCULATION OF CRITICAL MASSES OF SPHERICAL REACTORS WITH INFINITE REFLECTOR. A translation of "Priblizhennyi Metod Rascheta Kriticheskikh Mass Sfericheskikh Reaktorov s Beskonechnym Otrazhatelem." G. I. Marchuk and V. P. Kochergin (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 12p.

A method is proposed which makes it possible to recalculate the critical masses of spherical reactors with infinite reflectors for various enrichments of uranium, from the known values of the critical parameters at 100% enrichment with U^{235}. The method can be extended to include the case of mixture of fissionable substances, if their density is the same. For changing densities of fuel and moderator, the possibility is shown of recalculating the critical dimensions for reactors without reflectors. (auth)

Elementary Particles and Radiations

9353 (AE-62) A MONTE CARLO SAMPLING TECHNIQUE FOR MULTI-PHONON PROCESSES. Thure Hoegberg (Aktiebolaget Atomenergi, Stockholm). Dec. 1961. 10p.

A sampling technique for selecting scattering angle and energy gain in Monte Carlo calculations of neutron thermalization is described. It is supposed that the scattering is separated into processes involving different numbers of phonons. The number of phonons involved is first determined. Scattering angle and energy gain are then chosen by using special properties of the multi-phonon term. (auth)

9354 (AERE-BIB-135) NUCLEON-NUCLEON SCATTERING. A BIBLIOGRAPHY, 1957 TO 1961. H. A. Stoddart and B. J. Wilson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1961. 27p.

A total of 258 references is given on nucleon-nucleon (p-p and n-p) scattering at all energies. (D.L.C.)

9355 (DEG-Report-248) THE PREPARATION OF URANIUM-235 ISOTOPIC STANDARDS BY BLENDING. A. N. Hamer and B. R. Grundy (United Kingdom Atomic Energy Authority. Development and Engineering Group, Capenhurst, Ches., England). Oct. 1, 1962. 44p.

Recommended procedures are described in detail, which enable uranium isotopic standards to be prepared with precisions approaching 1 part in 10^4. The stoichiometry of uranium oxide (U_3O_8) and the weighing process are discussed. Factors affecting the accuracy of weighing solid uranium oxide are discussed, and suitable methods for handling small quantities of material by solution methods are described, together with experimental verification of their reliability. Numerical examples are given of the method of calculating the sensitivity of the balance, the weighing of an object, and the calibration of a set of weights. Sources of error are summarized, and the preparation of blends used to calibrate a uranium standard in this laboratory is described. (auth)

9356 (INSJ-45) PROTON-PROTON SCATTERING AT 50 MEV. [PART] I. K. Nisimura, J. Sanada, I. Hayashi, S. Kobayashi, D. C. Worth, H. Imada, N. Ryu, K. Fukunaga, H. Hasai, Sung Baik Nung, and Y. Hiradate (Tokyo Univ. Inst. for Nuclear Study). Dec. 1, 1961. 8p.

The differential cross section for the p-p interaction at 52 Mev laboratory energy is measured at laboratory angles of 6 to 45° (i.e., at center-of-mass angles of 12.2 to 90.8°). (T.F.H.)

9357 (MURA-405) LIFETIME OF AN ELECTRON IN A RELATIVISTIC PROTON BEAM. R. H. Bieri (Midwestern Universities Research Assn., Madison, Wis.). Apr. 25, 1958. Contract AT(11-1)-384. 5p.

The electron removal from the space charge potential of a relativistic proton beam by Coulomb interaction only is considered. It is calculated that the maximum permissible neutralization of an 800 amp beam of 15-Bev protons in this case would be reached after 4×10^{-4} sec. This result indicates that the electric sweeping fields mentioned in the new proposal are unavoidable. (auth)

9358 (NP-11263) THE $K^+_{\mu 3}$ AND K^+_{e3} DECAY THROUGH A CURRENT OF DEFINITE ISOTOPIC RANK. J. L. Acioli and S. W. Mac Dowell (Rio de Janeiro. Centro Brasileiro de Pesquisas Físicas). 1961. 16p. (Notas de Física, Vol. VIII, No. 9, p.163-75).

The energy distribution and polarization of muons and electrons are calculated assuming an interaction through a vector current of definite isospin character, and using form factors obtained by means of dispersion relations. The effect of the K^* resonance is taken into account. The spectra, and to a less extent the polarizations, are quite insensitive to this effect. (auth)

9359 (NP-11358) A MEASUREMENT OF SPIN CORRELATION IN PROTON-PROTON SCATTERING AT 400 AND 450 MEV. Technical Report No. 28. Eugene Engels, Jr. (Princeton Univ., N. Y. Palmer Physical Lab.). Jan. 30, 1962. Contract Nonr-1858(06). 80p.

The spin correlation coefficients C_{nn} and C_{KP} for proton-proton scattering at 400 and 450 Mev at 90° in the center-of-mass system were measured using spark chambers containing carbon plates as the polarization analyzers. The results obtained are: C_{nn}(400 Mev) =

0.60 ± 0.09, C_{KP} (400 Mev) = 0.32 ± 0.09, C_{nn}(450 Mev) = 0.70 ± 0.15, and C_{KP}(450 Mev) = 0.37 ± 0.14. The results of the 400 Mev measurements are consistent with predicted values for these coefficients obtained by extrapolating the p-p phase shifts from lower energies. Phase shift extrapolations to 450 Mev are not as yet available. (auth)

9360 (TID-14827) TECHNICAL PROGRESS REPORT [ON PARTICLE PHYSICS]. (Chicago. Univ.). [1961]. Contract AT(11-1)-264. 16p.

Various projects on elementary particle interactions and decays and quasi-particles are described, and a bibliography of published works is given. (D.L.C.)

9361 (TID-14846) KINEMATICS OF ELEMENTARY PARTICLE REACTIONS (thesis). Harry C. Meyer, III (Vanderbilt Univ., Nashville. Graduate School). May 1959. 68p.

A method was developed for finding all possible reactions for a given pair of initial particles. All possible reactions for a Λ, Σ, Ξ, $\bar{\Xi}$, $\bar{\Sigma}$, and $\bar{\Lambda}$ incident on a nucleon at rest and at 25 Mev were determined and their thresholds calculated. The possible product particles and their production thresholds were also found for a N, K, π, Y, $\bar{K}$, and $\bar{N}$ incident on a nucleon at rest or at 25 Mev. A formula for the maximum laboratory kinetic energy of one of the particles produced in a given reaction as a function of the energy of the initial particles was derived and used to calculate the maximum energy of each particle when it is produced by a pion or nucleon incident on a nucleon at rest or at 25 Mev. The possibility of determining the total number of reactions as a function of the number of product particles for a given pair of initial particles is discussed. (D.L.C.)

9362 (UCRL-9606) REGENERATION OF θ_1 MESONS IN A THIRTY-INCH PROPANE BUBBLE CHAMBER (thesis). Robert H. Good (California. Univ., Berkeley. Lawrence Radiation Lab.). July 1961. Contract W-7405-Eng-48. 79p.

A beam of θ_2 mesons was produced by passing a beam of 1.1 Bev/c negative pions through a liquid hydrogen target and accepting the neutral reaction products in the forward direction after allowing the θ_1 component to decay. The resultant beam was filtered through four inches of lead and was then observed in a 30-inch propane bubble chamber. Regeneration of the θ_1 component was observed both in lead and iron plates inside the bubble chamber and in the propane itself. About 200 regenerated θ_1 mesons were identified by their characteristic Q-value and decay rate. The observed angular distribution of the θ_1 mesons demonstrated three types of regeneration: incoherent, from individual nucleons; diffraction, from all of the nucleons in a nucleus acting coherently; and transmission, from coherent action of all the matter in the plate as a whole. The Gell-Mann-Pais particle mixture hypothesis is thus further substantiated. (auth)

9363 (FTD-TT-61-394) RADIATION OF GRAVITATIONAL WAVES BY "ELEMENTARY PARTICLES." K. P. Stanyukovich. Translated from Vestnik Moskov. Univ. Ser. III, No. 5, 71-82(1961). 16p.

The radiation of gravitational waves by nucleons is considered. It is proposed that the waves can arise as a consequence of the "spin" of a meson cloud near the nuclear core. The radiation bears a quadrupole character. The energy borne away by the gravitational waves is calculated. It is proposed that in this manner it is possible to explain the gravitational field of particles, for which purpose the dimensions of the core ($r_0^* \approx 10^{-14}$ cm) and the pulse frequency of the meson cloud ($\omega_0 \approx 10^{24}$ sec^{-1}) are calculated. (auth)

9364 CONTRIBUTIONS TO THE STUDY OF LIFETIMES OF POSITRONS IN SOLIDS. Teuvo Kohonen (Institute of Tech., Laboratory of Technical Physics, Otaniemi, Finland). Ann. acad. Sci. Fennicae, Ser. A, VI, No. 92, 1-79(1961). (In English)

Theoretical and experimental distributions of lifetimes of positrons in solid media are discussed. Lifetimes were measured using a fast time-to-amplitude converter system, the electronic resolution of which was 110 ± 10 picosec. Lifetimes of positrons in Al, Cu, Cd, Na, and brass were 130 ± 20, 170 ± 25, 120 ± 25, 210 ± 25, and 160 ± 25 picosec, respectively. The longer-lived component τ_2 was measured in molecular substances. In polyethylene, τ_2 was determined at −193 to +132°C. Results support the assumption that it is mainly the free volume between the polymers which determines the $^3S \rightarrow {}^1S$ conversion rate of positronium. Instrumental aspects are discussed, and methods to eliminate sources of error are suggested. (auth)

9365 SIMPLIFIED SELF-ABSORPTION CORRECTION FOR ISOTOPES EMITTING WEAK β-PARTICLES. Titus C. Evans, Jr. (State Univ. of Iowa, Iowa City). Biochim. et Biophys. Acta, 56: 349-53(Jan. 29, 1962). (In English)

A modification of Hendler's method for adjusting C^{14} specific-activity values to compensate for self-absorption is proposed. This altered technic permits simplification of computation and reduction of all data to a single reference specific activity. Determination of the approximate specific activity at zero self-absorption, evaluation of the slope-constant of self-absorption for the sample material, and ready comparison of specific activities of samples of different materials and thicknesses are additional advantages. (auth)

9366 A METHOD OF SOLVING THE PROBLEM OF MANY BODIES ON A DIGITAL COMPUTER IN THE CASE OF CHARGED PARTICLES. S. P. Lomnev (Computer Center, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 141: 1065-7(Dec. 11, 1961). (In Russian)

The relativistic equations of motion of M charged particles interacting in an external field are given. The number of initial equations can be limited to 100 by dividing the volume V_0 containing the charges into small equal volumes ΔV_k with the total charge concentrated at the center. The motion of a beam of charged particles in a linear electron accelerator is investigated. At small currents (<0.1 amps) the separation in the radial direction can be estimated from the behavior of the boundary differential volumes. The particles near the axis do not oscillate very much and it can be estimated that the beam does not change in a radial direction for $r_0 < 2/3\ r_{0\ max}$. Only a small region near the phase of the equilibrium particle $\phi_0 = \pi$ (about one degree) has an effect on the primary broadening of the beam. The remainder of the bunch does not change much in a radial direction. Broadening of the particle beam is greater in the radial direction than in the longitudinal direction, and cannot be compensated by an increase in the focusing field strength H_z. The loss of particles to the walls increases with an increase in the current of injected particles I_{inj}. This effect becomes greater with an increase in $d\beta_0/dz$ (β_0 is the phase velocity of the wave) and with an increase in $d\epsilon_0/dz$ ($\epsilon_0(z)$ is the voltage amplitude of the accelerating field of the traveling wave). Hence, in order to increase the particles captured at the walls $I_{cap.}$, it is necessary to have β_0 = const and ϵ_0 = const (as high as possible) so that the phase oscillations in the accelerator are at a minimum.

A similar approach can be used for a linear proton accelerator, a synchrotron or a cyclotron with a variable magnetic field. (TTT)

9367 SCATTERING OF WAVES AND PARTICLES BY INHOMOGENEOUS REGIONS. L. I. Schiff (Stanford Univ., Calif.). J. Opt. Soc. Am., 52: 140-4(Feb. 1962).

A review is given of the classification of types of wave motion of physical interest. Effects of the wave medium, nonlinearity, transformation properties, interaction between wave systems, and quantization are discussed briefly. Examples are given of the analogy between electromagnetic and Schrödinger waves, and of the calculational methods used both in normal mode and in scattering problems. (auth)

9368 THE ANGLE OF DIVERGENCE OF PAIRS PRODUCED BY PHOTONS IN A CRYSTAL. A. Levi (Università, Genoa). Nuovo cimento (10), 22: 471-86 (Nov. 1, 1961). (In English)

The distribution of the angle of divergence of pairs produced by high-energy photons in a crystal differs in many features from the usual one-atom distribution. This difference is calculated by taking into account the number of reciprocal points corresponding to the various angles. The result is that if the photon beam impinges on the crystal normally to a lattice plane, although the total cross section is less than the one-atom cross section, there are some angles at which large constructive interferences occur. If, on the other hand, the photon beam makes a small but finite angle θ with the normal to a lattice plane, the crystal distribution oscillates around the one-atom distribution. (auth)

9369 A REDETERMINATIONS OF THE PANOFSKY RATIO. V. T. Cocconi, T. Fazzini, G. Fidecaro, M. Legros, N. H. Lipman, and A. W. Merrison (CERN, Geneva). Nuovo cimento (10), 22: 494-518(Nov. 1, 1961). (In English)

The Panofsky ratio is measured using an NaI(Tl) γ-ray spectrometer. The accuracy is limited by the statistical error, but not by the resolving power of the spectrometer or by other sources of systematic errors. The final result is $P = 1.533 \pm 0.021$. (auth)

9370 A THEORETICAL APPROACH TO HIGH-ENERGY PION PHENOMENA. D. Amati (CERN, Geneva), S. Fubini, A. Stanghellini, and M. Tonin. Nuovo cimento (10), 22: 569-87(Nov. 1, 1961). (In English)

A theoretical analysis of the main features of high-energy strong interactions is performed. By applying dispersion theory to the elastic scattering amplitude for high-energy interactions with low momentum transfer. Expressions are obtained for the shape of diffraction scattering and for the total cross sections. The form of those results suggests a definite model for the most important inelastic processes. In this model a well-defined group of Feynman graphs, the "most peripheral" ones, gives the dominating effect in high-energy collisions. (auth)

9371 QUASI-ELASTIC NUCLEON-NUCLEUS SCATTERING AT HIGH ENERGY. R. Karplus and Y. Yamaguchi (CERN, Geneva). Nuovo cimento (10), 22: 588-603(Nov. 1, 1961). (In English)

The angular distribution for elastic nucleon-nucleon scattering at high energy is sharply peaked in the forward direction. As a consequence, there is an angular interval in nucleon-nucleus scattering to which successive small-angle elastic nucleon-bound nucleon scatterings are more likely to contribute than a single nucleon-bound nucleon scattering through the angle of observation. Such "plural" collisions result in outgoing nucleons that suffer a smaller energy loss than nucleons that are scattered from hydrogen at the same angle. The Fermi motion of the bound nucleons produces a broadening in the energy distribution of the scattered nucleons, but displaces the center of the distribution negligibly. The results of calculations with a simple model are in agreement with the observations on proton-carbon scattering. (auth)

9372 SOME CONSEQUENCES OF SPIN $\frac{3}{2}$ FOR Ξ. Alladi Ramakrishnan, G. Bhamathi, S. Indumathi, T. K. Radha, and R. Thunga (Univ. of Madras). Nuovo cimento (10), 22: 604-9(Nov. 1, 1961). (In English)

Consequences of the assignment of spin $\frac{3}{2}$ for the cascade particle (Ξ) are investigated. The Ξ-p and $\bar{\Xi}$-p interactions are analyzed for both even and odd Ξ-N parity. The binding energies of double hyperfragments, produced by the nuclear capture of Ξ are also calculated. The decay systematics of the Ξ are also given. (auth)

9373 MOMENTUM-SPIN CORRELATIONS IN PHOTOELECTRIC EFFECT AND IN SINGLE QUANTUM POSITRON ANNIHILATION. H. Kolbenstvedt and H. Olsen (Inst. of Theoretical Physics, N.T.H., Trondheim, Norway). Nuovo cimento (10), 22: 610-30(Nov. 1, 1961). (In English)

The transverse polarization of photoelectrons, and the photon emission asymmetry with respect to the polarization plane in single quantum annihilation of transversely polarized positrons, is calculated in the lowest non-vanishing order Born approximation. The effects are of the same nature and of the same order of magnitude as the polarization and asymmetry effects in Mott scattering. The momentum spin correlation in quantum theory of radiation is shown to be proportional to the imaginary part of the matrix element integrals. The fact that the correlation only occurs in the second order Born approximation, the first order Born approximation matrix element integrals being real, is closely related to time reversal invariance. (auth)

9374 Y* AND TWO-NUCLEON K^--CAPTURES. N. N. Biswas (Max-Planck-Institut für Physik und Astrophysik, Munich). Nuovo cimento (10), 22: 654-6 (Nov. 1, 1961). (In English)

The capture of K^- mesons at rest by nuclei is considered, using the interactions $K^- + d \rightarrow Y^* + N \rightarrow Y + N + \pi$ and $K^- + d \rightarrow Y + N$ (Y = hyperons, Y* = pion-hyperon resonant state, and N = nucleon) as examples. These interactions are assumed to be identical, with the exception that the pion emitted in the first (one-nucleon) interaction is real, while the pion emitted in the second (two-nucleon) interaction is virtual and is absorbed by the nucleon. This assumption is used to find theoretically the ratio (r) of two-nucleon to one-nucleon interactions, the orbital angular momentum of the emitted pion, and the Y* mass, spin, and parity relative to Y. These predictions are compared with experimental results. The effect of the atomic mass of the capturing nucleus on r is also studied. (T.F.H.)

9375 SEARCH FOR MAGNETIC MONOPOLES. M. Fidecaro, G. Finocchiaro, and G. Giacomelli (CERN, Geneva). Nuovo cimento (10), 22: 657-60(Nov. 1, 1961). (In English)

Attempts are described to detect particles having a monopole magnetic charge. Theory predicts for this particle a charge of 137/2e, a mass of about 2.4 Bev, and a production cross section of greater than 10^{-34} cm^2 in nucleon-nucleon (N-N) collisions. Experimental attempts at direct monopole detection in N-N collisions, and at detection of monopole-antimonopole annihilation, set the upper limit of the production cross section at 10^{-38} cm^2 or less. In arriving at this upper limit, it is assumed that the

particle has a mass less than 2.8 Bev and a charge on the order of the theoretical value. (T.F.H.)

9376 NEUTRINO AND THE CHANGING OF CONCEPTS. S. M. Ayub. Pakistan J. Sci. and Ind. Research, 4: 129-30(July 1961). (In English)

Various concepts are briefly discussed on the conservation of mass and energy as they apply to neutrino. One theory expresses the concept that the neutrino mass could be $\frac{1}{50}$ m_e. (N.W.R.)

9377 LEFT-RIGHT ASYMMETRY IN PAIR ANNIHILATION FOR TRANSVERSALLY POLARIZED POSITRONS. S. C. Miller and R. M. Wilcox (Univ. of Colorado, Boulder). Phys. Rev., 125: 629-30(Jan. 15, 1962).

A left-right asymmetry of the photons in the electron-positron annihilation cross section is found for the case when only the incident positron is polarized. This asymmetry results from a radiative correction. In the calculation the target electron is unpolarized and it is assumed that the polarizations of the resulting photons are not measured. The maximum asymmetry found is several parts in ten thousand. (auth)

9378 PRODUCTION OF CHARGED PIONS IN COLLISIONS OF 450-Mev PROTONS WITH VARIOUS NUCLEI. Endre Lillethun (Univ. of Chicago). Phys. Rev., 125: 665-76(Jan. 15, 1962).

The differential production cross sections for positive and negative pions by 450-Mev protons on Be, C, Al, Cu, Sn, Sb, Au, Pb, and U were measured. The energy spectra were measured for carbon at 21.5° and 60° in the laboratory. The variation of cross section as a function of atomic mass number is compared to theoretical curves based on a model where the nucleus is assumed to have a surface layer of neutrons. There is good agreement between the data and the theoretical predictions. The energy spectrum at 21.5° for carbon shows that the positive pions are produced with energies up to the energy expected for the reaction $p + C^{12} \rightarrow \pi^+ + C^{13}$ with the final carbon nucleus left unexcited. The spectrum for negative pions, however, goes to zero at a lower energy, consistent with the fact that a similar two-body reaction is not possible. (auth)

9379 PION PRODUCTION IN PION-NUCLEON COLLISIONS AND THE PION-PION INTERACTION. Emma Perez Ferreira (Comisión Nacional de Energía Atómica, Buenos Aires). Phys. Rev., 125: 676-8(Jan. 15, 1962).

Momentum distributions of the pions of all charge states produced in the interaction of 960-Mev π^- mesons with protons are calculated assuming a primary $\pi-\pi$ interaction followed by a $\pi-N$ interaction with excitation of the (3,3) isobar state of the nucleon. Predicted spectra are in reasonable agreement with experimental data when the $\pi-\pi$ resonance energy is assumed to be about 700 Mev. (auth)

9380 NUCLEON-NUCLEON INTERACTIONS AT ENERGIES GREATER THAN 10^{12} ev. P. L. Jain (Univ. of Buffalo). Phys. Rev., 125: 679-87(Jan. 15, 1962).

A primary jet of type 2 + 16p and a high-energy secondary jet of the same type as that of the primary, i.e., 2 + 16p, were observed in nuclear emulsion. A very high energy electromagnetic cascade was also observed in the primary interaction. Both the primary and the secondary interactions were considered as nucleon-nucleon interaction for their analysis. The energy as calculated from the angular distribution of the shower particles of the primary and of the secondary events is 3.1×10^{12} and 2.5×10^{12} ev, respectively. The estimate of the energy of the primary event is also obtained from its total energy dissipated. The validity of the energies of the primary as well as of the secondary events as obtained from their angular distribution is discussed. The average transverse momentum of the shower particles is ~0.30 Bev/c. The energy and the angles of shower particles of both these events are transferred to the c.m. system which shows sharp collimation of particles of high energy at small angles with the shower axis. The energy distribution in the c.m. system for both these events is peaked towards low values but shows a remarkably long tail at high energies extending up to 12 Bev. Analysis of both these events is consistent with the "two-fireball" model. (auth)

9381 SPIN AND PARITY OF THE ω MESON. M. L. Stevenson, L. W. Alvarez, B. C. Maglić, and A. H. Rosenfeld (Univ. of California, Berkeley). Phys. Rev., 125: 687-90(Jan. 15, 1962). (UCRL-9856)

The spin and parity of the ω meson were determined to be 1^- by a quantitative comparison of the density of points on the Dalitz plot with the predicted density of points. The simplest matrix element for the $J = 1^-$ meson (which predicts maximum density of points at the center of the Dalitz plot and zero density on the boundary) fits the data remarkably well, but the simplest matrix elements for 1^+ and 0^- mesons (both of which predict zero density at the center of the plot) do not fit. A quantitative treatment for higher J values was attempted. However, the simplest matrix elements for $J = 2^+$ and 2^- also vanish at the center of the Dalitz plot, and are again inconsistent with the data. (auth)

9382 $\pi^{\pm}-p$ TOTAL CROSS SECTIONS IN THE RANGE 450 TO 1650 Mev. Thomas J. Devlin, Burton J. Moyer, and Victor Perez-Mendez (Univ. of California, Berkeley). Phys. Rev., 125: 690-700(Jan. 15, 1962). (UCRL-9548 (Rev.))

The total cross sections for positive and negative pions on hydrogen were measured at frequent intervals in the energy range from 450 to 1650 Mev. Six scintillation counters measured the transmission of pions at solid angles, and results were extrapolated to zero solid angle. The two peaks previously discovered in the π^--p cross section are centered at 600 ± 15 Mev and 900 ± 15 Mev. A broad maximum was observed in the π^+-p cross section at approximately 1350 Mev. A "shoulder" at approximately 800 Mev, in a region where the π^+-p cross section is rapidly rising, supports speculation that there is a resonant state at this energy. (auth)

9383 APPLICATION OF GENERAL UNITARITY TO PION-NUCLEON SCATTERING. K. Meetz (Princeton Univ., N. J.). Phys. Rev., 125: 714-28(Jan. 15, 1962).

The $\pi-\pi-N$ intermediate state is included in the unitarity condition of pion-nucleon scattering. The general unitarity relations then couple the amplitudes for $\pi-N$ and $\pi-\pi-N$ scattering, and one-pion production or absorption. The kinematical structure of these amplitudes is discussed and a formal decomposition into partial waves is outlined. The dynamical approach is based on a system of coupled partial wave dispersion relations. The dynamical singularities of $\pi-N$ scattering can be taken from the Mandelstam representation, whereas perturbation-theoretic approximations must be made for the other amplitudes. The dispersion relations can be solved by the generalized N/D method. As an example, a one-pion exchange approximation for the production and absorption amplitudes is considered. It is shown that amplitudes can be chosen which do not have any kinematical singularities. The N/D method here takes a more simple form by setting up integral equations for the N functions rather than for the D functions. Integrations over contours in the complex plane are then avoided. (auth)

9384 CONSERVATION OF HYPERCHARGE. G. Feinberg (Columbia Univ., New York). Phys. Rev., 125: 728-30(Jan. 15, 1962).

It is shown that the law of conservation of hypercharge follows from permutation symmetry of the Lagrangian provided that trilinear interactions are assumed. The permutation involves "primitive" isospin doublet fields, which are linear combinations of fields corresponding to the observed isospin doublets N, Ξ, K, K^G. No permutation symmetry for the observed particles is implied. If the assumption of trilinear interactions is not made, a multiplicative law of hypercharge conservation "modulo 4" is obtained. An argument is presented to show that this is inconsistent with experiment. (auth)

9385 EFFECT OF QUANTUM FLUCTUATION ON VERTICAL OSCILLATIONS OF AN ELECTRON MOVING IN A MAGNETIC FIELD. A. A. Sokolov, I. M. Ternov, and Yu. M. Loskutov (Moscow State Univ.). Phys. Rev., 125: 731-3(Jan. 15, 1962).

Two extreme cases of vertical motion of a radiating electron in a magnetic field are studied using Dirac's relativistic quantum theory. First, free motion of the electron along the magnetic field is considered (continuous spectrum). In the second case, the motion of the electron along the field is limited by a potential well with infinite walls (discrete spectrum). Analysis of these cases establishes a connection between quantum fluctuations and the classical radiation damping force. (auth)

9386 SEARCH FOR A SPIN-1 INTERMEDIATE MESON IN NEUTRAL PION PHOTOPRODUCTION. Michael J. Moravcsik (Univ. of California, Livermore). Phys. Rev., 125: 734-44(Jan. 15, 1962). (UCRL-6453)

If a spin-1 meson exists it might act as an intermediate particle in a meson current graph for neutral pion photoproduction. It is shown that the singularities from this graph are likely to be much closer to the physical region in the complex $x = \cos\theta$ plane than any other singularities with the possible exception of those coming from a pion-pion interaction. Thus an extrapolation can be carried out in x to determine the residue of the pole due to the spin-1 meson if it exists. This residue is calculated for vector (V) and pseudovector (PV) mesons and is found to have the same negative sign for both cases, unlike in the spin-0 case. Experimental data at 300, 450, 700, and 800 Mev are used for the extrapolation which is carried out as a function of intermediate meson mass. It is found that the results are consistent with zero residue for all energies with the possible exception of 450 Mev where there is a slight evidence for a positive residue. Thus present evidence favors the conclusion that there is no contribution to neutral photoproduction from a spin-1 meson. An upper limit of about 0.01 for the V case and 0.05 for the PV case is placed on the magnitude of $g^2(M/2m)^2$, where g is the coupling constant between the nucleon and the spin-1 meson, and the latter has a mass m and a magnetic moment M. An analysis is also given of the error in the residue determined from experimental data, as a function of the location and number of data points, the extrapolation distance, and the order of the extrapolating polynomial. It is concluded that the present error in the residue could be improved by a factor of 3 to 5 by an experiment measuring the differential cross section of neutral pion photoproduction at a photon energy of 800 Mev in the laboratory system at every 10° from 10° with an error of ± 0.2 μb/sr on the individual measurements. (auth)

9387 GLOBAL SYMMETRY RESONANCE IN PION-HYPERON SCATTERING. R. Arnowitt and J. Mazo (Syracuse Univ., N. Y.). Phys. Rev., 125: 744-5(Jan. 15, 1962).

Dispersion relations for fixed momentum transfer are applied to the problem of the Y_1^*, and it is shown that an s-wave resonance in π-Λ scattering does not appreciably influence the position of the p-wave π-Λ resonance predicted by global symmetry. (auth)

9388 EFFECT OF THE 3π RESONANCE ON THE 2π RESONANCE. R. Blankenbecler (Stanford Univ., Calif.). Phys. Rev., 125: 755-60(Jan. 15, 1962).

It is shown that the 4π intermediate state in π-π scattering is important in determining the position and perhaps even the existence of the π-π resonance. This large effect occurs by virtue of the 3π resonance. Quantitative estimates are given. The effect on nucleon form factors is discussed, and a model for these functions is proposed. The possibility of higher energy pion resonances is also considered. (auth)

9389 VERTEX FUNCTION, COUPLING CONSTANT, AND COMPOSITE PARTICLE. Lu Sun Liu (Univ. of Chicago). Phys. Rev., 125: 761-70(Jan. 15, 1962).

A vertex function with 3 kinds of strongly interacting particles is studied. As one of them becomes unstable, the structure singularities (one of which corresponds to the anomalous threshold) of this vertex function are shown to move out of the unphysical sheet and remain on the physical cut. In determining its dispersion relation, the correct Riemann sheet must be chosen for its absorptive part. A physical interpretation of this structure anomaly is given. Using this vertex function, a model of composite particles, stable or unstable, is discussed. The trilinear scalar-type coupling constant is obtained in terms of the three masses by using an unsubtracted dispersion relation of this vertex function. A method to estimate the lifetime of the unstable particle is proposed. Another condition between the coupling constant and the masses is obtained from consideration of the charge structure of the composite particle. The two independently obtained conditions can be used to determine both the coupling constant and the binding energy simultaneously. As an explicit example, Σ is considered as a bound state of Λ and π through a scalar-type $\Sigma\Lambda\pi$ coupling. The calculated mass of Σ is in agreement with its observed mass and the coupling constant is $g^2/4\pi = 1.4$. (auth)

9390 HYPERONS WITH AND WITHOUT DOUBLET SYMMETRY. Gregor Wentzel (Univ. of Chicago). Phys. Rev., 125: 771-6(Jan. 15, 1962).

Systems containing baryons with properties of Λ-Σ quartets in strong interactions with mesons which may be bound to form isobar states are considered. The model involves two independent coupling constants g and g'. It is shown that the case g = g' which corresponds to doublet (or global) symmetry is singular in that it is strongly affected by a certain quantum-mechanical resonance. (auth)

9391 PARTICLE THEORY APPROACH TO THE TWO-PION AND THREE-PION SYSTEMS. L. I. Schiff (Stanford Univ., Calif.). Phys. Rev., 125: 777-81(Jan. 15, 1962).

The relation between the 2-π and 3-π resonances is discussed in terms of a model in which the motion of the pions is described by a partially relativistic Schrödinger-type wave equation, and the interaction by a static potential. An attractive square-well potential that is almost strong enough to bind the di-pion gives a satisfactory account of the observed P-wave π-π scattering. If this potential is assumed to be additive between all pairs in the 3-π I = 0, $J = 1^-$ state, it produces far too much binding to agree

with observation. As an alternative to additivity, the interaction may be assumed to saturate, so that the total potential never exceeds that between any pair of pions. It is found that the model provides a qualitatively consistent explanation both of π-π scattering and the 3-π system if the pair interactions saturate or nearly saturate. (auth)

9392 ISOSCALAR NUCLEON STRUCTURE. R. Blankenbecler (Princeton Univ., N. J.) and Jan Tarski. Phys. Rev., 125: 782-90(Jan. 15, 1962).

The 3-π contribution to the isoscalar nucleon structure is examined in dispersion theory. It is assumed that the amplitudes (photon → 3 pions) and (3 pions → nucleon pair) are characterized by the pions interacting in pairs. This interaction is taken to be the low energy J = T = 1 resonance, which consequently dominates the picture. The effects of a 3-π interaction are included so as to satisfy an extended unitarity condition. The lowest mass singularities, including the complex ones, are discussed, interpreted, and included. If the π-π resonance is at $10\mu^2$, then a reasonable radius can be easily obtained. On the other hand, if the resonance is at $20\mu^2$ or higher, then a strong intrinsic 3-π resonance or a bound state seems to be needed for agreement with experiment. (auth)

9393 EXCITED HYPERON OF MASS 1520 MEV. Massimiliano Ferro-Luzzi, Robert D. Tripp, and Mason B. Watson (Univ. of California, Berkeley). Phys. Rev. Letters, 8: 28-31(Jan. 1, 1962).

Investigations of the K^-p interaction at about 400 Mev/c were made. Cross sections for K^- momenta were measured, and momentum dependence of the cross section for reactions $K^- + p \rightarrow \Lambda + \pi^+ + \pi^-$ and $K^- + p \rightarrow \bar{K}^0 + n$ was observed. Existence of an excited hyperon with 1520 ± 3 Mev mass, $\Gamma/2 = 8$ Mev half width, 0 isotopic spin, even parity with respect to K^-p (D_{1_2}), and branching ratios of $\bar{K}N : \Sigma\pi : \Lambda 2\pi = 3 : 5 : 1$ was established. (L.N.N.)

9394 EVIDENCE FOR A T = 1 PION-PION RESONANCE AT 575 MEV. Roland Barloutaud (Centre d Etudes Nucleaires, Saclay, France), Jacques Heughebaert, Antoine Leveque, Joao Meyer, and Roland Omnes. Phys. Rev. Letters, 8: 32-3(Jan. 1, 1962).

Single pion production in the reaction $\pi^+ + p \rightarrow \pi^+ + \pi^0 + p$ at incident pion kinetic energies of 820, 900, and 1050 Mev was studied. Histograms showing the distribution of events as a function of the kinetic energy $Q_{\pi\pi}$ in the rest systems of the two resultant pions are presented. Evidence for a di-pion resonance with isotopic spin T = 1 at 575 ± 20 Mev is reported. (L.N.N.)

9395 OBSERVATION OF μ^- CAPTURE IN LIQUID HYDROGEN. Roger H. Hildebrand (Argonne National Lab., Ill. and Univ. of Chicago). Phys. Rev. Letters, 8: 34-7 (Jan. 1, 1962).

A 99½% pure muon beam from the Chicago cyclotron is brought to rest in an 8-liter hydrogen bubble chamber. The incoming particles are identified as muons by their residual range versus curvature in the 20-kilogauss field of the chamber. The reaction $\mu^- + p \rightarrow n + \nu$ is identified by the absence of a decay electron and by the appearance of a recoil proton created by the neutron. Pion captures and μ captures in elements of Z > 1 are excluded in identification. Nondecaying meson tracks are not associated with recoil protons due to the general background of low-energy neutrons near the meson beam. The energy of a neutron emitted from the end of a meson track must be determined with adequate precision by measuring the range and direction of a recoil proton it is supposed to have caused. (L.N.N.)

9396 LOW-ENERGY CHARGED MESON PHOTOPRODUCTION. J. K. Walker and J. P. Burq (Ecole Normale Superieure, Orsay, France). Phys. Rev. Letters, 8: 37-40(Jan. 1, 1962).

To resolve a discrepancy existing as an energy or angular dependence in the reaction $\gamma + p \rightarrow \pi^+ + n$, angular distributions of π^+ mesons from hydrogen at 185 Mev gamma energy were measured using a Bremsstrahlung beam of maximum energy 220 Mev produced by an electron linear accelerator. The meson counting rate was calibrated at a given meson energy under the kinematical conditions in which experimental sets of data at fixed momentum transfer were used (NSA, 15: 31537). The cross section is known and described by the Chew-Goldberger-Low-Namber theory. Results are in agreement with those of M. Beneventano et al. (Nuovo Cimento 4: 323(1956)) and in disagreement with M. I. Adamovich et al. (Proceedings of the 1960 Annual International Conference on High Energy Physics at Rochester, 330(1960)). (L.N.N.)

9397 REGGE TRAJECTORIES AND THE PRINCIPLE OF MAXIMUM STRENGTH FOR STRONG INTERACTIONS. Geoffrey F. Chew (Univ. of California, Berkeley), and Steven C. Frautschi. Phys. Rev. Letters, 8: 41-4(Jan. 1, 1962).

A general statement of the principle of maximum strength is given in terms of Regge poles, and qualitative and quantitative experimental predictions that follow are explained. Internal consistency was obtained experimentally. (L.N.N.)

9398 P-WAVE INTERACTIONS IN τ DECAY. Mirza A. Baqi Beg and Paul C. DeCelles (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 8: 46-7(Jan. 1, 1962).

Independent calculations of the low-energy S-wave π-π interaction indicate that it is attractive in the T = J = 0 state and much stronger than in the T = 2, J = 0 state. Existing data on τ decay appear to contradict these conclusions and suggest that the interaction in the T = J = 0 state is repulsive. It is shown that this discrepancy is resolved by taking into account the known P-wave π-π interaction in τ and τ' decays. Effects of a P-wave K-π interaction are also included but are shown to be less important. (L.N.N.)

9399 THE ELECTROMAGNETIC STRUCTURE OF PROTONS AND NEUTRONS. H. Schopper. Physik. Bl., 17: 316-25(July 1961). (In German)

The structures of protons and neutrons were studied, including the anomalous magnetic moment by electron scattering experiments. The results indicated that the protons and neutrons are made up of nuclei surrounded by clouds of charge. The charge distribution of the proton and neutron possesses a nucleus containing 35% of the charge and with a radius of about 0.2 fermi. In the proton this nucleus is surrounded by two possitive clouds, but in the neutron the inner cloud contains a negative charge. The outer cloud leads to a weak positive covering. The anomalous magnetic moment results from a cloud with a radius of 0.8 fermi, which is positive for the proton and negative for the neutron. (M.C.G.)

9400 SINGLE PARTICLE VERSUS COLLECTIVE EXCITATION IN THE DIRECT INTERACTIONS. Taro Tamura and Tokuo Terasawa (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 26: 285-303(Sept. 1961). (In English)

A detailed but phenomenological analysis is made in estimating the contribution of the single-particle excitations to the integrated cross sections σ'_{pp} and σ_{pn} of the (p,p') and

(p,n) reactions. It is found that, if the experimentally known collective-excitation cross section is added (which is in fact added only to the former), the resulting integrated cross sections agree with experiments and explain why $\sigma'_{pp} \gg \sigma_{pn}$. It should be noted, however, that the contribution of the collective excitation to σ'_{pp} is only a small fraction of σ'_{pp}, contrary to the supposition that it is the main part of σ'_{pp}. More basic considerations of the mechanism of the direct interactions are also made, using the T-matrix formalism. Discussions are given concerning the description of collective excitation in the inelastic scattering process as a superposition of single-particle excitations and the reason that the excitation of the collective states is expected to be small in the transmutation reactions. (auth)

9401 THE POLARIZATION OF DEUTERON. Yasutaro Takahashi (Tokyo Coll. of Science). Progr. Theoret. Phys. (Kyoto), 26: 315-20(Sept. 1961). (In English)

The polarization in elastic scattering of deuterons from spin–zero targets is discussed on the basis of diffraction theory using the polarization formalism of Wolfenstein, Lakin and Stapp. The D-state contribution of deuterons is small, especially for small angles, in results of cross section and polarization for 94–Mev deuteron elastic scattering. (auth)

9402 INTEGRAL REPRESENTATIONS FOR SCATTERING AMPLITUDES IN PERTURBATION THEORY. Noboru Nakanishi (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 26: 337-55(Sept. 1961). (In English)

Integral representations for scattering amplitudes are proposed that are more general than the Mandelstam representation. Support properties are investigated for practical cases and for the general case in every order of perturbation theory. Nambu-Symanzik's formula is proved in terms of the Feynman parametric integral, and an example (for the two-particle scattering) is given in which stability conditions are satisfied but no dispersion relation holds. (auth)

9403 K MESON-PION INTERACTION AND $K^- + p \rightarrow \overline{K}^0 + \pi^- + p$ REACTION. Shigeo Minami (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto), 26: 356-74(Sept. 1961). (In English)

$\overline{K}$ meson-pion interaction is studied considering the effects of K*. The value of the coupling constant for $\overline{K}\pi K^*$ interaction and the magnitude of cross section of $\overline{K}$-π scattering are estimated assuming the isotopic-spin of K* to be 1/2. Using the value of the coupling constant, the reaction $K^- + p \rightarrow \overline{K}^0 + \pi^- + p$ is investigated at 1.15 and 2 Bev/c. The total cross sections and the angular distributions and momentum spectra of protrons and pions are examined. It is shown that the assumption of S = 1 (S indicates the spin of K*) rather than that of S = 0 is consistent not only with the experimental results for the angular distribution of $K^- + p \rightarrow K^* + p$ process but also with those for $K^- + p \rightarrow \overline{K}^0 + \pi^- + p$ reaction at 1.15 Bev/c, that is, the magnitude of cross section and the energy spectrum of the pion. (auth)

9404 ELASTIC π^--p SCATTERING AT 1.4 Bev. Shigeo Minami (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto), 26: 375-80(Sept. 1961). (In English)

The analysis of experimental results for π^--p collisions at 1.4 Bev is made considering effects of real parts of the scattering amplitude. It is shown that the approximation in which the real parts of phase shifts are neglected is not necessarily good. (auth)

9405 REMARKS ON THE LOW-LYING BARYON ISOBARS. R. E. Marshak and S. Okubo (European Organization for Nuclear Research, Geneva). Progr. Theoret. Phys. (Kyoto), 26: 381-90(Sept. 1961). (In English)

Relative energies and widths of low-lying baryon isobars were examined from the point of view of the global symmetry hypothesis. Energy shifts of the hyperon isobars Λ^* and Σ^* due to the mass differences between the baryons were calculated, independent of the dynamics. (auth)

9406 A SIMPLE MODEL FOR TWO-CHANNEL REACTION IN FIELD THEORY AND ITS APPLICATION TO THE Y PROBLEM. Yasunori Fujii (Nihom Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 26: 391-417(Sept. 1961). (In English)

A simple two-channel model in field theory is presented in order to know characteristic features of the problems concerning Y* recently observed. Four particles, K^-, N, π, and Λ, all assumed to be spinless, are considered, and the S-state amplitudes are calculated in the chain approximation. The calculated amplitudes satisfy the unitarity condition and reproduce bound states, resonances, and other features of the reactions. From the examples treated it is concluded that a strong attractive force between K^- and N, such that there is a bound state, and a weak coupling between K-N and π-Λ channels are essential for the appearance of a sharp peak both in the K-N total cross section and the $K^- + N \rightarrow \pi + \Lambda$ cross section in the unphysical region. The relation between height and width is such that the peak tends to a δ-function if the width tends to an infinitesimal. This conclusion remains unchanged, even if a force between π and Λ is varied over a wide range. According to the variety of a π-Λ force, the π-Λ cross section exhibits either a peak or a dip near the energy at which the K^- N total cross section exhibits a peak. An attractive or a repulsive π-Λ force contributes to make a peak broader or narrower, respectively. (auth)

9407 REMARKS ON INTERACTING MANY-FERMION SYSTEM. Takeshi Ishihara and Masaru Yasuno (Univ. of Education, Tokyo and Kobayashi Inst. of Physical Research, Tokyo). Progr. Theoret. Phys. (Kyoto), 26: 422-4(Sept. 1961). (In English)

Dynamic correlation behavior of nuclear matter is considered. The two-particle scattering mode, including hole motion, is discussed. A definite phase shift is found in the wave function, indicating effects due to the attractive interaction, in turn due to the Pauli principle. This is true even though the original interaction consisted only of a repulsive core. The mode of the independent particle motion under the conditions may not be certified in the Fermi sea except in the neighborhood of the Fermi surface. (L.N.N.)

9408 THE APPLICATION OF MATRIX POLYNOMIALS TO DESCRIPTION OF ANNIHILATION OF N–$\tilde{N}$ PAIRS. Yu. I. Kulakov. Trudy, Moskov. Fiz. Tekh. Inst., No. 4, 102-20(1959).

Integral equations are derived for Tamm-Dancoff amplitudes describing annihilation of nucleon-antinucleon pairs with production of up to three π mesons. By employing the formalism of matrix polynomials, spin and angular variables are separated and the latter are reduced to the form suitable for numerical integration. (Referat. Zhur. Fig. No. 4, 1961.)

9409 BETA-RAY BACKSCATTERING FROM COMPOUNDS. V. S. Venkatasubramanian. p.163-9 of "Indian Institute of Science Golden Jubilee Research Volume, 1909-1959." Bangalore, India, Indian Institute of Science, 1959. (In English)

The backscattering factors were determined for a number of chemical compounds, and these are expressed in terms

of the values for the constituent elements by an equivalent atomic number, $\overline{Z}$ (for compound A_mB_n) = $mZ_A^2 + nZ_B^2/mZ_A + nZ_B$. Further, the maximum energies of the β-radiation backscattered from some compounds were determined by the aluminium absorption method and the results expressed by a formula $\log E_m = A + k \log \overline{Z}$. (auth)

9410 OBRATNAYA ZADACHA TEORII RASSEYANIYA. (Reverse Problem in Theory of Scattering). Z. S. Agranovich and V. A. Marchenko. Kharkov, Publishing House of Kharkov Order of the Red Banner, Gorkii State Univ., 1960. 268p.

The reverse problem of a quantum scattering system, which in its simplest form reduces the differential operator by the asymptotics of its normalized integral function, is analyzed. The detailed mathematical apparatus of the problem is presented. The book is designed for scientists and specialists interested in spectral theory of differential equations. (R.V.J.)

Neutron Physics

Refer also to abstract 9583

9411 (AAEC/E-78) SLOWING-DOWN SPECTRA OF NEUTRONS IN HEAVY WATER AND LIGHT WATER MIXTURES. M. Elaine Duncan, K. C. Hines, and J. P. Pollard (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Oct. 1961. 16p.

The slowing down spectra of neutrons were obtained for heavy water, light water, and mixtures of heavy water and light water. It was assumed that fission neutrons are produced uniformly throughout an infinite moderator and the only process considered was elastic scattering, spherically symmetric in the center-of-mass system. The (n,2n) reaction with the deuterium nucleus and absorption were assumed negligible. The average transfer cross section, fast diffusion coefficient, the slowing down area, and average velocity ratio were obtained for two-group calculations using the epithermal spectra. (auth)

9412 (AERE-R-3847) EXAMPLES OF THE THERMAL NEUTRON SCATTERING LAW. R. C. F. McLatchie, C. Heard, P. A. Egelstaff, and P. Schofield (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). July 1961. 78p.

The thermal neutron scattering law is described for such simple cases as Debye solids, diffusion, and the combination of solid and diffusion behavior. (auth)

9413 (CEA-2083) CONTRIBUTION A L'ETUDE DE LA DIFFUSION INELASTIQUE DES NEUTRONS DE 1 A 5 MeV. (Contribution to the Study of the Inelastic Scattering of Neutrons from 1 to 5 MeV). Dolly Abramson (France. Commissariat à l'Energie Atomique. Centre d'Études Nucléaires, Saclay). 1961. 110p.

Thesis submitted to Univ. of Paris.

A study was made to see if this reaction occurs only by compound nucleus formation or involves some contribution of direct interaction. In the first case, the angular distribution of inelastic neutrons is symetric about 90°. In the second case, this distribution must be asymetric and must change slowly with energy of incident neutrons. The neutrons corresponding at the excitation of a given level of the residual nucleus are selected by their coincidence with the γ rays of deexcitation of this level. From the results of measurements on iron, iodine, and bismuth and of other laboratories on different elements, it is concluded that generally, the inelastic scattering of neutrons of some Mev occurs only by compound nucleus. (auth)

9414 (KN-60-57(R)) THE NEUTRON FLUX FROM MONOENERGETIC POINT SOURCES IN AIR. Frank H. Shelton (Kaman Aircraft Corp. Kaman Nuclear Div., Colorado Springs). Dec. 7, 1960. 16p.

Graphs and tables are presented for the neutron flux from monoenergetic point sources having energies of 1 to 200 ev and 100 kev to 5 Mev. The ordinate $4\pi QR^2$ is unity for neutron propagation in a vacuum, Q being neutrons per unit area per source neutron. The abscissae of the figures are distance. (M.C.G.)

9415 (MS-91(2nd. Ed.)) REDUCTION IN NEUTRON DENSITY CAUSED BY AN ABSORBING DISC. T. H. R. Skyrme (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). 1944. Reprinted June 1961. 20p. Including MS-91A.

The reduction of thermal neutron density by an absorbing disc is calculated for both cases in which the disc is of large radius and in which the radius is comparable to the mean free path. (D.L.C.)

9416 (TID-14570) DIFFUSION COEFFICIENTS FOR HETEROGENEOUS SYSTEMS. D. S. Selengut (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Jan. 1962]. Contract [W-31-109-Eng-52]. 4p.

Summary of a paper to be presented at the American Nuclear Society Meeting, San Francisco, California, December 12-14, 1960.

In order to calculate the flux distribution and reactivity of a heterogeneous reactor, it is necessary to replace the actual lattice by an equivalent homogeneous medium. An analysis of this problem was made under the following limiting assumptions: diffusion theory is valid, only diffusion transverse to plane or cylindrical cells is considered, absorption is neglected, and the Wigner-Seitz approximation is made. Calculating the equivalent diffusion coefficients for a cylindrical lattice of arbitrary complexity was reduced to calculating the dipole reflection and transmission coefficients for homogeneous annular regions. (M.C.G.)

9417 (UCRL-6660) ISOTROPIC CONSTANT-CROSS-SECTION CALCULATIONS ON NEUTRON MULTIPLICATION IN A SMALL BARE HOMOGENEOUS SPHERE. Edward L. Kaplan (California. Univ., Livermore. Lawrence Radiation Lab.). Oct. 1961. Contract W-7405-eng-48. 26p.

A power-series solution of the integral equation satisfied by the neutron flux was derived and compared with results obtained by diffusion theory (in the region where the latter is least accurate) and the variational method. Agreement as to the criticality condition or multiplication rate was easily secured, but the neutron distribution was much less well determined by the approximate methods. Only the asymptotic solution with no sources other than fission was considered. The importance functions calculated may be suggestive for the conduct of Monte Carlo calculations. (auth)

9418 (AEC-tr-4716) DIFFUSION OF THERMAL NEUTRONS IN ANISOTROPIC MEDIA. A translation of "Diffuziya Teplovykh Neitronov v Anizotropnykh Sredakh." K. N. Mukhin, V. K. Makar'in, and A. P. Venediktov (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 22p.

The anisotropy of diffusion of thermal neutrons in heterogeneous media was measured. By using the indium detector method, the density distribution (z) of thermal neutrons from a flat source was measured for two variants of a heterogeneous lead-water medium: water — lead plates and water — lead rods. From the slope of the line ln $\rho(z)$, diffusion lengths were calculated for the thermal neutrons that diffuse parallel ($L_\parallel$) and perpendicular ($L_\perp$) to the layers of the lattice, and it was established that the diffusion is anisotropic ($L_\parallel \pm L_\perp$). The measurements were carried out with plates and rods of different thicknesses for different relative volumes of water and lead. The results obtained for lattices made of plates (flat lattices) agreed, within the limits of experimental accuracy, with the results of the theoretical calculations. For lattices made of rods, an experimental value was obtained for the dependence of the anisotropy of diffusion on the diameter of the rods and on the concentration of the medium. (auth)

9419 DIFFUSION CONSTANT MEASUREMENTS IN LIGHT WATER BY THE IMPULSE METHOD. R. Bayer, J. Červená, Z. Dlouhý, and W. Schaeferlingová (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Československ. časopis pro fysiku, A 11: 480-8(1961). (In Czech).

Apparatus is described for measuring the diffusion length L, the diffusion coefficient D_0, the mean life-time of thermal neutrons T, and the thermalization constant C by the impulse method. The method is analyzed and results of calibration measurements with light water are given. These agree with previous results. (auth)

9420 GENERALIZATION OF THE SINGULAR INTEGRAL METHOD FOR AN ANISOTROPIC SCATTERING MEDIUM. H. Takahashi (Brookhaven National Lab., Upton, N. Y.). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 15: 192-5(Dec. 1961).

The singular integral method suggested by Case (1960) for solving neutron diffusion problems in an isotropic scattering medium is generalized for a linearly anisotropic medium. The formulation of the anisotropic problem is the same as that of the isotropic scattering problem except for small correction terms. These correction terms are proportional to the absorption probability. In the case of a nonabsorbing medium, it is shown that the anisotropic scatterings affect only the asymptotic flux distribution and not the transient flux distribution. (auth)

9421 MEASUREMENTS OF THE DIFFUSION LENGTH OF THERMAL NEUTRONS IN WATER FROM 16 TO 89°C AND IN DIPHYL (DOWTHERM A) AT 185°C. J. Csikai, A. Daróczy, and K. Dede (Inst. of Nuclear Research, Hungarian Academy of Sciences, Debrecen). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 15: 204-8(Dec. 1961).

A stationary method was developed to determine the diffusion length of thermal neutrons in moderators containing hydrogen using only a small amount of material. The diffusion length of thermal neutrons was determined in water at temperatures 16.1, 47.8, 69.5, and 88.7°C; the resulting values were: 2.640 ± 0.028, 2.858 ± 0.024, 2.974 ± 0.064, and 3.092 ± 0.062 cm. In linear approximation, for the temperature coefficient of the diffusion length, in the 16 to 89°C temperature interval, a value of + 0.00617 ± 0.00086 cm/°C was obtained. In diphyl (Dowtherm A), the diffusion length of thermal neutrons at 184.4°C was 5.968 ± 0.266 cm. (auth)

9422 NUCLEAR THERMALIZATION IN PULSED MODERATORS. L. G. Kemeny and M. M. R. Williams (Queen Mary Coll., London). Nature, 193: 359-60(Jan. 27, 1962).

A theoretical investigation was made into the time-energy and space-energy behavior of a pulse of fast, fission energy neutrons introduced into non-multiplying, moderating media. Interesting results were obtained for the thermal region where the neutron energy is less than one ev and the neutron-nucleus scattering process is essentially quantum mechanical. The spatial dependence of the thermal neutron energy spectrum and its departure from the Maxwellian was investigated. A method for defining the region in a finite medium within which space and energy are accurately separable was established. The average energy as a function of position was also obtained. The behavior of a typical 1/v scatterer, such as water, is illustrated. (P.C.H.)

9423 SIGN OF THE ELECTRIC FORM FACTOR OF THE NEUTRON. W. R. Theis (Universität Hamburg). Phys. Rev. Letters, 8: 45(Jan. 1, 1962).

It is shown that measurements based on the Rosenbluth formula for electron scattering, together with the known value $F_{1n}'(0) = 0$ can determine the sign of F_{1n}. (L.N.N.)

9424 DISTRIBUTION OF THERMAL NEUTRONS IN A SOIL—WATER SYSTEM. Eugene R. Perrier and William R. Johnston (Univ. of California, Davis). Soil Sci., 93: 104-12(Feb. 1962).

The distribution of thermal neutrons from a point source of fast neutrons was measured in a 3-foot diameter by 3-foot-high barrel as a function of the soil-moisture content on a volume basis. From these data an empirical mathematical expression was determined relating count rate to moisture content. The effects of soil moisture interfaces on the count rate were measured, using a 55-gallon barrel atop another and placing homogeneous soils of different moisture contents in each barrel. In all cases the neutron count rate was biased by the proximity of the wetter soil, but, when the BF_3 tube was partially shielded with cadmium, the effect of the moisture interface was greatly reduced. Measurements of moisture interfaces when the bottom barrel was filled with water and the top barrel with soils of various moisture contents demonstrated the effect of neutrons escaping from or being reflected by a surface. (auth)

Nuclear Properties and Reactions

Refer also to abstract 9121 and 9122

9425 (AWRE-NR/P-7/61) EXCITATION FUNCTIONS AND ANGULAR DISTRIBUTIONS FOR TWO PROTON GROUPS IN THE REACTION O-16(He-3,p)F-18. D. Eccleshall and M. J. L. Yates (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Dec. 1961. 12p.

The excitation functions for proton groups feeding the ground and first excited states of F^{18} in the reaction $O^{16}(He^3,p)F^{18}$ were studied at laboratory angles of 15° and 60° and for bombarding energies between 4 and 8.5 Mev. Angular distributions were obtained at ten bombarding energies within this range for each of the two groups. The results show that the simple direct stripping theory gives a qualitative picture of the reaction mechanism although other effects, probably compound nucleus and distorted wave effects, are present. A new method for obtaining excitation functions using a magnetic spectrometer is described. (auth)

9426 (DC-57-12-182) FISSION DECAY CALCULATIONS. J. A. Delaney (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 19, 1957. Contract AT(11-1)-171. 18p.

An IBM 704 digital computer program is presented for the solution of N simultaneous linear 1st order differential equations describing the radioactive decay of a certain number of isotopes. (auth)

9427 (GA-2451(Vol.III)) NUCLEAR DATA FOR GAM-I DATA TAPE. VOLUME III. G. D. Joanou, J. S. Dudek, A. J. Goodjohn, N. F. Wikner, and J. D. Garrison (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Aug. 22, 1961. Contract AT(04-3)-314. 177p.

Data are included for the isotopes technetium-99 through lead for neutron cross sections and multigroup constants. (B.O.G.)

9428 (JINR-P-822) VREMYA OBRAZOVANIYA SOSTAVNOGO YADRA I γ-IZLUCHENIE PRI VZAIMODEISTVII ATOMNYKH YADER. (The Time for the Formation of a Compound Nucleus and γ-radiation in the Interaction of Atomic Nuclei). V. V. Babikov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1961. 10p.

The main features of the electromagnetic radiation of the compound–system which is assumed to consist of the two partially fused nuclei and to possess a high angular momentum have been obtained. An analysis of the experimental data on the γ-rays in heavy ion reactions indicate a qualitative agreement with the effects expected. The time for which the compound nucleus as a complete equilibrium system is formed has been estimated to be $\tau = 10^{-14}$ to 10^{-15} sec. (auth)

9429 (KAPL-M-PJT-9) COMPARISON OF CALCULATED AND MEASURED NEUTRON CAPTURES IN BORON AND URANIUM-235. (MEASUREMENTS PERFORMED IN PLASTIC MOCKUP ASSEMBLY-44, -45, AND -46). P. J. Tetrault and D. A. Gavin (Knolls Atomic Power Lab., Schenectady, N. Y.). Dec. 27, 1961. Contract W-31-109-eng-52. 37p.

The relative neutron absorption rates between a centrally located poison septum and the adjacent fuel plates were calculated and compared with measurements in the Plastic Mockup Assembly. Calculations and measurements are reported for three PMA slab cores each having the same fuel density of 0.056 g/cc U^{235} and the same metal-to-water ratio of 0.45. The cores were distinguished from one another by the poison's optical thickness ($\Sigma_a t$) of 0.6, 1.0, and 1.5 and the geometric buckling necessary to maintain criticality. The subcadmium neutron absorption rates which cover the energy range from 0 to 0.5 ev were predicted by the SWAKRAUM double Pl approximation to within the experimental uncertainty of ±5%. The epicadmium neutron absorption rates which cover the range from 0.5 ev to fission energies are predicted by the MUFTKARE programs to within the experimental uncertainty of ±7%. In general, the calculated neutron absorption rates showed a random deviation from the experimental values. No apparent bias was observed in either the fuel or the poison captures. (auth)

9430 (MRL-107) TWO-ELECTRON HEISENBERG EXCHANGE INTERACTION BETWEEN NEIGHBORING ATOMS. A. J. Freeman (Watertown Arsenal. Materials Research Lab., Mass.), R. K. Nesbet (Boston Univ.), and R. E. Watson (Avco Corp. Research and Development Div., Wilmington, Mass.). Nov. 1961. Contract DA-5-93-32-001. 14p.

The method of Nesbet is applied to the model investigated by Freeman and Watson to describe the Heisenberg exchange interaction between neighboring transition metal atoms. Pairs of atomic Hartree-Fock d orbitals obtained from calculations on Co^{++} and Co are used; the nuclei and the remaining electrons are represented by two point charges at the nearest neighbor internuclear separation of Co atoms in the metal. Nuclear charges, Z, of one and ten are used to examine the effect of changing the assumed potential. The effective Heisenberg exchange parameter is large and negative for all values of the parameters used. The results agree in sign with the earlier results of Freeman and Watson, who used the Heitler-London method without the ionic configuration, but differ by an order of magnitude for Z = 1, and are somewhat closer for Z = 10. (auth)

9431 (NARF-61-38T) EXPERIMENTAL INVESTIGATION OF RADIATION HEATING IN MATERIALS. O. H. Hill and E. E. Kerlin (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Dec. 29, 1961. Contract AF33(600) 38946. 126p. (MR-N-290)

An experimental study was performed to measure the nuclear-reactor radiation-induced heating rates in lead, 1018 steel, Marlex Type 2 Polyethylene, and an 80% lithium hydride-polyethylene matrix material. The data obtained from this study are compared with data predicted by methods employing computer techniques. Thermal transducers of the material types were fabricated to provide for the measurement of rate of temperature rise at some nine to twelve isolated planes in the material. The transducers were embedded in slabs of material which approximated an infinite half-plane configuration exposed to the reactor. Measurements are given of heating rates observed on the reactor centerline and at various off-centerline positions. (auth)

9432 (NP-11280) ISOTOPIC SPIN RELATIONS IN HYPERON PRODUCTION. Abdus Salam and J. Tiomno (Rio de Janeiro. Centro Brasileiro de Pesquisas Fisicas). 1961. 7p. (Notas de Física Vol. VIII, No. 8, p.155-60).

Experimental data on Σ−K production from π−p around 1 Bev gives the equality $\sqrt{\sigma^+} + \sqrt{\sigma^-} \approx \sqrt{2\sigma^0}$, where σ^+ is for $\pi^+ + p \rightarrow K^+ + \Sigma^+$, σ^0 for $\pi^- + p \rightarrow K^0 + \Sigma^0$, and σ^- for $\pi^- + p \rightarrow K^+ + \Sigma^-$. This is contrary to predictions by isotopic spin analysis. The results also indicate that $\sigma^+ \approx \sigma^- \approx \frac{1}{2}\sigma^0$, and the implications of this equality are examined on the basis of simple perturbation ideas. Feynman diagrams for $\pi + N \rightarrow K + \Sigma$ are given for even Λ−Σ and K−π parities. The role of K^* exchange in odd Λ−Σ and even K−π parities is discussed. (D.L.C.)

9433 (NP-11294) NUCLEAR REACTIONS BIBLIOGRAPHY. (Library of Congress. Aerospace Information Div., Washington, D. C.). Dec. 15, 1961. 96p. (AID-Report-61-7)

A bibliography is presented as a guide to Soviet literature on nuclear reactions. The material covered are the Soviet sources available at the Aerospace Information Division and the Library of Congress prior to June 1960. The 682 entries are arranged alphabetically by author within each of the followings 13 subject headings: Coulomb excitation, deuteron-induced reactions, neutron-induced reactions, proton-induced reactions, reactions induced by alpha particles, reactions induced by gamma quanta and electrons, reactions induced by light nuclei, reactions induced by heavy ions, reactions induced by mesons (π), nuclear fission, thermonuclear reactions and plasma, photonuclear reactions, and general and miscellaneous. (M.C.G.)

9434 (NP-11360) PARTICLE PRODUCTION AT LARGE ANGLES BY 10-33 BEV PROTONS INCIDENT ON ALUMINUM AND BERYLLIUM. Technical Report No. 29. V. L. Fitch, S. L. Meyer, and P. A. Piroué (Princeton Univ., N. J. Palmer Physical Lab. and Princeton Univ., N. J. Naval Ordnance Lab.). Jan. 31, 1962. Contract Nonr-1858(06). 16p.

A mass analysis was made of the relatively low-momentum particles emitted from aluminum and beryllium targets when struck by 10- to 33-Bev protons. The measurements were made at 13.25, 45, and 90° relative to the incident proton beam, and momentum distribution spectra are presented. The emitted particles include pions, protons, helium-3, deuterons, and tritons. (D.L.C.)

9435 (ORNL-3240) THE DISTORTED-WAVE THEORY OF DIRECT NUCLEAR REACTIONS. I. "ZERO-RANGE" FORMALISM WITHOUT SPIN-ORBIT COUPLING, AND THE CODE SALLY. R. H. Bassel, R. M. Drisko, and G. R. Satchler (Oak Ridge National Lab., Tenn.). Feb. 9, 1962. Contract W-7405-Eng-26. 104p.

The distorted-wave theory of direct nuclear reactions is presented in a unified manner, in which the effects of assuming various reaction mechanisms and nuclear models appear only in certain radial form factors. The zero-range approximation is used, and spin-orbit coupling is neglected in the distorted waves. Formulas are given for transition amplitudes, cross sections, and polarizations. A description is given of the IBM-704 computer code SALLY that is based on these formulas. (auth)

9436 (TID-14211) VIRTUAL COULOMB EXCITATION IN THE NUCLEON TRANSFER PROCESS. G. Breit (Yale Univ., New Haven). [1961]. Contract AT(30-1)-1807. 22p.

[Presented at] Conference on Electromagnetic Lifetimes and Properties of Nuclear States, October 5-7, 1961, Gatlinburg, Tennessee.

A discussion of nucleon transfer reactions is presented. The characteristic feature of such reactions is that a nucleon leaves the target or projectile and attaches itself to one of these. It appears fair to conclude that under some conditions virtual coulomb excitation is a major contributor to the nucleon transfer process and must be considered in the quantitative interpretation of data on many nucleon transfer reactions if reliable values of reduced widths are to be derived from the observations. (J.R.D.)

9437 (TID-14628) A STUDY OF F^{20} (thesis). Stanley S. Glickstein (Pennsylvania State Univ., University Park). Nov. 16, 1961. Sponsored by OOR and AEC under Contract DA-36-061-ORD 592. 80p. (AROD-1911.5)

An investigation was made of various properties of F^{20}. The F^{20} beta transition to the ground state of Ne^{20}, the F^{20} beta transition to the excited states of Ne^{20}, measurement of the F^{20} half-life, and the thermal neutron activation cross section of F^{19} are discussed. Different methods were used in studying the properties of F^{20} and the results are compared. (auth)

9438 (TID-14786) PROGRESS REPORT FOR APRIL 1, 1961–MARCH 31, 1962 [ON USE OF BUBBLE CHAMBER]. Ugo Camerini and William F. Fry (Wisconsin. Univ., Madison). Contract AT(11-1)-881. 12p.

Bubble chamber photographs are analyzed, to study the $K_1^0-K_2^0$ mass difference, K^0 leptonic decay, π meson production by K^+ mesons in propane, the polarization of protons from K-p interactions, Λ scattering on hydrogen, hyperfragment lifetimes, and other meson and hyperon interactions. Operations of several bubble chambers are summarized. (T.F.H.)

9439 (TID-14822) A STUDY OF THE REACTIONS, $Be^9(He^3,n)C^{11}$, $Li^7(He^3,N)B^9$ AND $C^{13}(He^3,n)O^{15}$, BY TIME-OF-FLIGHT TECHNIQUES. Jerome Lewis Duggan (Oak Ridge National Lab., Tenn.). Feb. 1961. Contract [W-7405-Eng-26]. 135p.

Thesis submitted to Louisiana State Univ., Baton Rouge.

Angular distributions and excitation functions were measured for the reactions $Be^9(He^3,n)C^{11}$, $Li^7(He^3,n)B^9$, and $C^{13}(He^3,n)O^{15}$, by time-of-flight techniques. Distorted and plane wave stripping calculations were made in an attempt to fit the measured angular distributions. In the distorted wave calculations, the distortion is introduced by scattering from both the Coulomb field and the nuclear optical potential. The calculations show that the distorted wave angular distributions can be made to fit the data while the plane wave calculations fail except for those angular distributions which are peaked strongly in the forward direction. For the $Be^9(He^3,n)C^{11}$ reaction, resolved neutron groups were seen for the ground state and the first four excited states (1.99, 4.26, 4.75, and 6.50 Mev) in C^{11}. Excitation functions were measured at 0 and 90° for He^3 energies from 0.5 to 2.7 Mev and angular distributions measured at 2.1 Mev. From the distorted wave calculations, the following spin and parity assignments were made; $n_0(\frac{1}{2}^- \rightarrow \frac{1}{2}^-)$, $n_1(\frac{1}{2}^- \rightarrow \frac{1}{2}^-)$, $n_2(\frac{1}{2}^- \rightarrow \frac{1}{2}^-)$, and $n_4(\frac{3}{2}^-)$. For the $Li^7(He^3,n)B^9$ reaction, neutrons from the ground state were clearly resolved from the unresolved second and third excited states. An excitation function was measured from 0.5 to 2.7 Mev at 0° and an angular distribution was taken at 2.1 Mev for the ground state group. Distorted wave calculations give a spin and parity assignment of $(\frac{1}{2}^- \rightarrow \frac{1}{2}^-)$ for this group. For the $C^{13}(He^3,n)O^{15}$ reaction, resolved neutron groups were seen for the ground state and third excited state (6.15 Mev) in O^{15}. Excitation functions were measured from 1 to 2.7 Mev at 0 and 90°. The most outstanding feature of the excitation function is the resonance at a He^3 center of mass energy of 1.55 Mev. This resonance corresponds to a new state in O^{16} at an excitation of 24.04 Mev. This state has a laboratory width of ~100 kev. Angular distributions were measured for the ground and third excited states at 2.66 Mev. From the distorted wave calculations, the following spin and parity assignments were made; $n_0(\frac{1}{2}^-)$ and $n_3(\frac{5}{2}^+ \rightarrow \frac{1}{2}^+)$. In summary it might be said that the angular distributions from the (He^3,n) reactions studied, though complex in nature, can be fitted with distorted wave calculations, even at low energies. Furthermore it appears that the (He^3,n) reactions can be used to make spin and parity assignments to many of the proton-rich nuclides which are virtually inaccessible by other reactions. (auth)

9440 (TID-14823) HAFNIUM RESONANCE INTEGRAL MEASUREMENTS. F. Feiner and K. V. Cooper (Knolls Atomic Power Lab., Schenectady, N. Y.). [1960?]. Contract [W-31-109-Eng-52]. 7p.

For presentation at the American Physical Society Meeting, New York City, January 24-27, 1962.

Reactivity signal measurements were made on both bare and cadmium-covered samples of hafnium of varying isotopic content in the Thermal Test Reactor. Comparison of the experimental values with the values calculated from resonance structure reveal no consistent discrepancy which might be ascribed to particle self-shielding, and it is concluded that the resonance integral for natural hafnium is near 2000 barns. (D.L.C.)

9441 (TID-14854) DETERMINATION OF THE K-FLUORESCENCE YIELD OF VANADIUM-51 (thesis). Richard Eugene Johnston (Vanderbilt Univ., Nashville. Graduate School). June 1958. 44p.

The K-series fluorescence yield of V^{51} due to electron capture decay of Cr^{51} was measured with a proportional counter spectrometer to be 0.304 ± 0.026 by using electroplated sources of Cr^{51}. This value is an average of three separate determinations. Additional work was done in order to try to explain the presistent low energy tail associated with all the data obtained. A measurement of the range of the 4.44-kev Auger electrons in the source backing material was also attempted. (auth)

9442 (TID-14963) AUGER AND CONVERSION SPECTRUM OF RADIUM D (thesis). Norman Keith Lee (Vanderbilt Univ., Nashville. Graduate School). June 1958. 35p.

The Auger spectrum above 5 kev and the 46.7 kev gamma conversion lines of radium D (Pb^{210}) were studied. A source, somewhat weaker than desired, was prepared by thermal evaporation of the Pb^{210} on platinum. The intensities of the conversion lines were measured and found to be 1, 0.054 ± 0.003, 0.008 ± 0.002, 0.238 ± 0.006, 0.053 ± 0.003, and 0.014 ± 0.002. A measurement of the L Auger yield gave 0.62 ± 0.04. A 61-kev beta was found and the branching ratios for it and the 16.5-kev beta were measured to be 0.15 ± 0.05 and 0.85 ± 0.05 respectively. (M.C.G.)

9443 (WASH-1034) REPORTS TO THE AEC NUCLEAR CROSS SECTIONS ADVISORY GROUP, COLUMBIA UNIVERSITY, DECEMBER 4-5, 1961. John R. Stehn (Nuclear Cross Sections Advisory Group, AEC). Jan. 1962. Contract [AT(30-2)-Gen-16]. 35p.

An informal statement of recent developments, changes of emphasis, and preliminary date which are of importance to the cross section measurement program is presented for various laboratories. (M.C.G.)

9444 (AEC-tr-4710) AVERAGE NUMBER OF PROMPT NEUTRONS IN FISSION OF Pu-240 BY NEUTRONS WITH ENERGY 3.6 AND 15 Mev. A translation of "Srednee Chislo Mgnovennykh Neitronov pri Delenii Pu-240 Neitronami Energiei 3.6 Mev i 15 Mev." B. D. Kuz'minov (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 6p.

A study was made of the average number of prompt neutrons in the fission of Pu^{240} by monochromatic neutrons. The neutrons were obtained from the reactions D(d, N)He^3 and T(d, N)He^4 at energies of 3.6 and 15 Mev respectively. A value of 3.25 ± 0.15 was obtained for the average number of prompt neutrons at 3.6 Mev and 4.4 ± 0.2 at 15 Mev. (M.C.G.)

9445 (UCRL-Trans-767(L)) ON THE MEASUREMENT OF LIFETIMES OF THE LEVELS 3^3P AND 3^1P OF HELIUM ATOMS BY THE METHOD OF DELAYED COINCIDENCES. A. L. Osherovich and I. G. Savich. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Optika i Spektroskopiya, 4: 715-18(1958). 8p.

The lifetime of the 3^3P level of He is measured to be $(1.00 \pm 0.08) \times 10^{-7}$ sec, and the lifetime of the 3^1P level is estimated to be $(3.3 \pm 0.2) \times 10^{-8}$ sec. (T.F.H.)

9446 SOME REMARKS ON THE THEORY OF PHOTODISINTEGRATION OF Be^9 AND Li^7. A. Kowalska (Jagellonian Univ., Krakow). Acta Phys. Polon., 20: 1019-20 (1961). (In English)

Corrections in the theory of the reactions $Be^9(\gamma,n)Be^8$ and $Li^7(\gamma,H^3)He^4$ are introduced. (auth)

9447 NOTE ON POSITRON RADIATION FROM Pr^{140}. S. Chojnacki (Univ. of Warsaw), J. Kopystyński, Z. Preibisz, R. Sosnowski, J. Zylicz, and I. Yatlandov. Acta Phys. Polon., 20: 1021-3(1961). (In English)

The positron spectrum of Pr^{140} was investigated using a magnetic long lens spectrometer. It was established that the Kurie plot is a straight line from 350 to 2366 ± 24 kev, the maximum. (auth)

9448 EXCITED STATES OF Pt^{192}. Lennart Simons, Erik Spring, and Gerhard Wendt (Univ. of Helsinki). Acta Polytech. Scand., Phys. Nucleonics Ser., No. 15, 1-31 (1961). (In English)

Measurements of γ-γ angular correlations were made for transitions in Pt^{192} following β decay of Ir^{192}. The measured correlation function of the 468 to 316-kev cascade is in agreement with previous measurements and confirms the assignment of spin 4 to the 784-kev level. By measuring the 300 to 300-kev correlation and the 600 to 300 kev correlation, a spin of 3 can be assigned to the 921-kev level. The correlations of the 600 to 300 kev, 588 to 613 and 885 to 316-kev cascades require a spin of 4 for the 1201-kev level. A measurement of the correlation of the 1065 to 316-kev cascade allows either spin 3 or spin 4 for the 1381-kev level. Thus the levels at 613, 921 and 1201 kev have spins 2, 3, and 4, respectively. Data on β-decay of Ir^{192} and multipoles of the gamma rays suggest that these levels have positive parity. From this and other evidence it is argued that these levels form a rotational band with K = 2 based on the gamma-vibrational level at 613 kev. (auth)

9449 THE USE OF THICK SOURCES IN ALPHA SPECTROMETRY. G. Graeffe and M. Nurmia (Univ. of Helsinki). Ann. Acad. Sci. Fennicae, Ser. A, VI, No. 77, 1-14(1961). (In English)

Expressions for the differential and integral spectra of infinitely thick alpha sources are derived. Measurements on thick sources of U, Sm, Pt, and W are described. The following are obtained: Sm^{147}: 2.23 ± 0.05 Mev, $T_{\frac{1}{2}} = 1.13 \times 10^{11}$ years; Pt^{190}: 3.16 ± 0.05 Mev, $T_{\frac{1}{2}} = 6.8 \times 10^{11}$ years; W: No activity with $T_{\frac{1}{2}} \cdot$ (abundance) $< 10^{15}$ years · %. The accuracy of the $T_{\frac{1}{2}}$ values is mainly limited by the available stopping cross-section values. It is estimated that with present method the limit of detection is 10^{16} years · %. (auth)

9450 ENERGY DISTRIBUTION OF α-PARTICLES FROM THE PHOTODISINTEGRATION OF ARGON. A. P. Komar, B. A. Bochagov, and G. E. Solyakin (Inst. of Physics and Tech., Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 141: 1339-42(Dec. 21, 1961). (In Russian)

A collimated beam of 70-Mev gamma rays was passed through a sample of argon gas. The α-particles from the Ar^{40} $(\gamma,\alpha)S^{36}$ reaction were counted on a grid ionization chamber which had been calibrated by counting α-particles of natural uranium. The maximum range of the particles counted at a pressure of 1 atmosphere was 9 cm which corresponds to an energy of 2.3 Mev for protons, 3.05 Mev for deuterons, 3.54 Mev for tritons, 8.1 Mev for He^3 and 9.08 Mev for He^4 particles. It was possible to count the particles in the 3.5 to 9.0-Mev region by varying the negative bias on the grid. At a pressure of 1, 1.3, 2 and 3 atmospheres of argon in the chamber, the energy maxima were found to be 4.6, 4.87, 4.4 and 4.3 Mev, and the half-widths were 2.62, 2.72, 3.20 and 3.65 Mev. The effect of counting protons, deuterons and tritons was small because of the small difference in spectral distribution at various pressures. The experimental energy spectrum of α-particles having a maximum at 4.8 Mev and a half-width of 3.3 Mev was compared with the theoretical spectrum calculated from statistical theory for the $Ar^{40}(\gamma,\alpha)S^{36}$ reaction. The experimental maximum is shifted by 2.0 Mev toward the lower energies. This discrepancy can be explained by a contribution from the $Ar^{40}(\gamma,\alpha n)S^{35}$ re-

action, or by assuming a higher value for the penetrability of the coulomb barrier. (TTT).

9451 THE EMISSION OF HIGH-ENERGY ALPHA PARTICLES IN NUCLEAR SPALLATION REACTIONS WITH PROTONS. Zh. S. Takibaev, E. V. Shalagina, and G. R. Tsadikova (Kazakh State Univ., SSR). Doklady Akad. Nauk S.S.S.R., 141: 1347-9(Dec. 21, 1961). (In Russian)

An intensive search for high-energy, alpha particles was conducted on collisions involving 9-Bev protons that were detected in photoemulsion stacks. The α particle was first identified only from the range (9 cm for an α particle, and 0.3 to 0.4 cm for a proton). A 1- to 2-Bev α particle will still leave a track 30 cm long with a grain density of $>4\ g_{min}$. The kinetic energy of the α particles was determined from measurements of the multiple coulomb scattering. It was observed that an alpha particle could be characterized by the width of the track that it leaves in the emulsion. In all, 14 α particles were found with energies of 100 to 2000 Mev. Thus, it is proved that high-energy alpha particles are emitted in nuclear spallation reactions involving 9-Bev protons. (TTT)

9452 THE EFFECT OF THE ENERGY OF A RADIOACTIVE EMITTER ON THE EVAPORATION RATE OF A SOLID. I. E. Zimakov and Vikt. I. Spitsyn (Inst. of Physical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 141: 1400-2(Dec. 21, 1961). (In Russian)

The rate of evaporation of MoO_3 depends on the specific activity of the sample. Samples of MoO_3 (0.25 to 0.5 mm grain size) were prepared that contained Y^{90}(E_{max} = 2.18 Mev), Mo^{99}(E_{max} = 1.23 Mev) and W^{185}(E_{max} = 0.43 Mev). Dry air or nitrogen at a rate of 10 ml/min and a temperature of 700°C was passed over about 200 mg of MoO_3 in a quartz boat. The evaporation rate of the MoO_3 was determined from the change in weight of the quartz boat with time. With the W^{185} and Mo^{99} activities there is an initial fall in the evaporation rate at a specific activity of 5 mc/g for W^{185} and of 7 to 8 mc/g for Mo^{99}. Then, the evaporation rate increases with increasing specific activity of the preparation. There was a continuous increase in evaporation rate with increasing specific activity in the case of Y^{90}. The rate of evaporation of MoO_3 was higher, the higher the energy of the beta emitter incorporated in the MoO_3. (TTT)

9453 THE FISSION CROSS SECTION OF ^{233}U FROM 0.01 EV TO 0.1 EV AND ITS ABSOLUTE VALUE AT 0.0253 EV. A. J. Deruytter (Centre d'Etude de l'Energie Nucléaire, Mol, Belg.). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 15: 165-75(Dec. 1961).

The absolute fission cross section of U^{235} at the reference neutron velocity of 2200 m/sec was measured. The counting rate of a 4π fission chamber was compared with that of a B^{10} ionization chamber by alternate measurements in a neutron beam emergent from the thermal column of BRI. The energy selection was done with a slow chopper previously calibrated with respect to the sharp breaks of σ_t for α Fe, Be, Bi, Al, and C (graphite). The efficiency of the B^{10} chamber was compared to the well-known absorption cross section of Au^{197} by activation measurements with a (β-γ) coincidence technique. The thickness of the U^{235} layer was determined by comparison with α-standards of the same isotopic composition, and controlled by a mass-spectrometric method. The determination yields: σ_f^0 = (587 ± 6) barns. Some information is also obtained about the nearby negative energy levels. (auth)

9454 MULTIPLE SCATTER CORRECTIONS BY MONTE CARLO. J. B. Parker, J. H. Towle, D. Sams, and P. G. Jones (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Instr. & Methods, 14: 1-12(Nov. 1961). (In English)

Two Monte Carlo programs written to correct measurements of neutron scattering cross sections for effects due to the finite dimensions of the scattering sample are described. The first program calculates multiple scatter corrections to be applied to the experimentally determined ratio $\sigma_{in}:\sigma_{el}$, and also obtains the flux attenuation correction. The second enables the shapes of the experimentally determined differential elastic and inelastic cross sections to be corrected for multiple scatter. An account of an application of the programs to measurements of the scattering of 1.5-Mev neutrons by Na^{23} is also given. (auth)

9455 EQUATIONS FOR ALPHA-DISINTEGRATION ENERGIES. Y. P. Varshni, and R. N. Bhargava (Allahabad Univ., India). Nuovo cimento (10), 22: 449-56(Nov. 1, 1961). (In English)

For nuclei with $Z \geq 84$ and $N \geq 128$, it is shown that $(Q - 0.625\ Z)$ is a smooth function of the mass number A, where Q is the α-disintegration energy. This relation is utilized to develop two equations for Q. Results by these two equations are compared with those given by Roger's equation. (auth)

9456 ON THE DECAY BY ELECTRON CAPTURE OF Ar^{37}. C. Manduchi and G. Zannoni (Universita, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo cimento (10), 22: 462-70(Nov. 1, 1961). (In Italian)

The L and K x radiations of Cl^{37} resulting from orbital electron capture are studied using a multiwire proportional counter system. The L/K capture ratio of Ar^{37} is determined to be 0.0971 ± 0.0005. The average energy of the L peak is found to be (254 ± 2) ev. (auth)

9457 INVESTIGATION OF THE NUCLEAR SURFACE BY MEANS OF THE ELASTIC SCATTERING OF HEAVY IONS. J. A. McIntyre, S. D. Baker, and K. H. Wang (Yale Univ., New Haven). Phys. Rev., 125: 584-94(Jan. 15, 1962).

An investigation was made to determine the relevant parameters in the elastic scattering of alpha particles and heavy ions by nuclei. It was shown by the analysis of typical alpha-particle scattering data that the qualitative features of the scattering are determined by the strength of the Coulomb interaction and the radius of the ion-nucleus interaction. Two experiments with different nuclei were performed where the above two parameters were kept fixed in order to determine whether differences in the scattering would appear due to a third parameter, say, the nuclear surface thickness. Two doubly-magic nuclei, O^{16} and Pb^{208}, were used in the first scattering experiment while two aspherical nuclei, F^{19} and Tb^{159}, were used in the second scattering experiment. Differences in the scattering did occur between the two experiments. However, it is not possible to conclude that the differences are due to nuclear surface effects because of the inclusion of inelastic scattering in the data taken in the second experiment. An indication that there is not a difference between the "surfaces" of the Pb^{208} and Tb^{159} nuclei was shown by making a partial-wave analysis of data of elastic scattering of alpha particles by these nuclei. (auth)

9458 GAMMA RADIATION FROM PROTON CAPTURE IN Na^{23}. F. W. Prosser, Jr., W. P. Unruh, B. H. Wildenthal, and R. W. Krone (Univ. of Kansas, Lawrence). Phys. Rev., 125: 594-9(Jan. 15, 1962).

Gamma decays of 12 resonances in the reaction $Na^{23}(p,\gamma)Mg^{24}$ in the proton energy range from 0.58 to 1.42 Mev were re-examined with large scintillation detectors

and coincidence techniques. Weaker cascades through the states of Mg^{24} between the excitation energies of 6 and 8 Mev were found. Relative intensities were measured for the observed γ rays and consistent decay schemes proposed. Absolute yields were determined. (auth)

9459 PROTON TRANSFERS IN THE NITROGEN–BORON SYSTEM AT 27.5 Mev. E. Newman (Oak Ridge National Lab., Tenn.). Phys. Rev., 125: 600-5(Jan. 15, 1962).

The proton transfer reactions, (1) $B^{10}(N^{14},O^{15})Be^{9}$, (2) $B^{10}(N^{14},C^{13})C^{11}$, and (3) $B^{11}(N^{14},C^{13})C^{12}$, leaving the reaction products in their ground states were investigated at 27.5 Mev. To distinguish these reactions from other events, the two product particles were detected in coincidence by silicon surface-barrier counters. In addition, a proportional counter imposed the requirement that the observed particle have the correct charge. Angular distributions (1) and (2) peak at $r_0 \approx 2.2$ fermis when plotted as $d\sigma/dR_{min}$ vs r_0, where R_{min} is the distance of closest approach for a Rutherford orbit and $r_0 = R_{min}/(A_1^{1/3} + A_2^{1/3})$. The total ground-state cross sections were determined to be (1) 1.34 ± 0.30 mb, (2) 2.19 ± 0.49 mb, and (3) less than 0.3 mb. The data are compared with the predictions of the tunneling theory, and good agreement is found for the initial rise of the angular distribution. (auth)

9460 EXCITATION FUNCTIONS FOR HEAVY-ION-INDUCED REACTIONS ON ALUMINUM-27. Inge-Maria Ladenbauer-Bellis, Ivor L. Preiss, and C. E. Anderson (Yale Univ., New Haven). Phys. Rev., 125: 606-12 (Jan. 15, 1962).

Excitation functions for C^{12}-, N^{14}-, and O^{16}-induced reactions on aluminum-27 were studied using stacked-foil techniques and the ion beams of the Yale Heavy Ion Accelerator. Yields of $Cl^{34,38}$, P^{32}, $Al^{28,29}$, Mg^{27}, Na^{24}, and F^{18} were measured in the energy range from 10.5 to about 1 Mev per nucleon. The production of the radionuclides $Cl^{34,38}$, P^{32}, and in the case of C^{12} irradiation Al^{28}, are due to evaporation processes from a compound-nucleus system, while the production of F^{18}, Na^{24}, Al^{28}, Al^{29}, and Mg^{27} seems to occur by a direct-interaction mechanism. A comparison of the yields for specific radionuclei produced by different beams is given. (auth)

9461 GAMMA YIELD FROM THE PROTON BOMBARDMENT OF TRITIUM. C. C. Gardner and J. D. Anderson (Univ. of California, Livermore). Phys. Rev., 125: 626-8(Jan. 15, 1962). (UCRL-6314)

The Livermore 90-in. variable-energy cyclotron was used to measure the excitation function for the $T(p,\gamma)He^4$ reaction for proton energies between 5.8 and 9.2 Mev at a laboratory angle of 90°. The γ radiation was produced in a 0.12-Mev-thick tritium gas target and detected in a 5-in.-diam by 6-in.-long NaI(Tl) crystal. Gamma angular distributions were measured at E_p = 5.8, 6.4, 7.7, 8.4, and 9.2 Mev and were found to be peaked at angles less than 90°, the asymmetry increasing with proton energy. No evidence was found for excited states of He^4 reported by C. Milone (Phys. Rev. 120: 1302(1960)). (auth)

9462 ELASTIC SCATTERING OF PROTONS BY SINGLE ISOTOPES. Clyde B. Fulmer (Oak Ridge National Lab., Tenn.). Phys. Rev., 125: 631-8(Jan. 15, 1962).

Differential cross sections for elastic scattering of 22.2-Mev protons were measured for 20 targets of predominantly single isotopic composition at ~$2\frac{1}{2}$° intervals over the angular range of 20 to 150°. The targets ranged from Mg^{24} to U^{238} and included three pairs of isobars. Cross sections for elastic scattering of 16.4- and 9.5-Mev protons were also measured for Ni^{64} and Zn^{64} at ~$2\frac{1}{2}$-deg intervals over the angular range of 25 to 120°. The 9.5-Mev data for Ni^{64} and Zn^{64} show differences in the positions of maxima and minima of the elastic scattering angular distributions that are consistent with a dependence of real nuclear potential well depth on the nuclear symmetry parameter (N−Z)/A. The 22.2-Mev data indicate that the positions of minima and maxima of the elastic scattering angular distributions are not appreciably influenced by closed nucleon shells nor by variation of (N−Z)/A. The 22.4-Mev data indicate that elastic scattering at large angles is influenced by nuclear deformation. (auth)

9463 NUCLEAR ELECTRIC MONOPOLE TRANSITIONS IN O^{16}, Ca^{40}, Ge^{72}, AND Zr^{90}. M. Nessin, T. H. Kruse, and K. E. Eklund (Columbia Univ., New York) Phys. Rev., 125: 639-47(Jan. 15, 1962).

A study was made of electric monopole transitions from the 0^+ first excited states of certain nuclei. A search for 6.05-Mev O^{16} E0 conversion electrons gave an upper limit of 1×10^{-4} for the ratio of the probability for conversion electrons to that of pair emission. Ca^{40} E0 conversion electrons were observed and a ratio of $W_{conversion}/W_{pair} = (6.94 \pm 0.20) \times 10^{-3}$ was obtained. The momentum distributions of both components of pairs from the first excited state were observed. An upper limit of 6×10^{-3} was placed on the ratio of double gamma emission to pair emission. The energy of the first excited state was found to be 3.353 ± 0.003 Mev by measurement of the conversion electron energy. An excitation function for population of the first excited state of Ge^{72} by inelastic scattering of protons was observed between 2.3 and 6.2-Mev proton bombarding energy. The K and (L + M + N + O) E0 conversion electrons were resolved and the ratio $W_K/W_{(L+M+N+O)} = 8.70 \pm 0.06$ was obtained. The energy of the first excited state was 0.690 ± 0.001 Mev. An excitation function for population of the first excited state of Zr^{90} by inelastic scattering of protons was obtained between 3.35 and 6.5 Mev. The momentum distributions of both components of pairs were observed. The energy of the first excited state was measured as 1.762 ± 0.002 Mev. 2.38 ± 0.08 was obtained for the ratio $W_{conversion}/W_{pair}$. The K and (L + M + N + O) conversion electrons were resolved and the ratio $W_K/W_{(L+M+N+O)} = 7.06 \pm 0.08$ was obtained. All results are consistent within experimental errors with theoretical predictions. (auth)

9464 DIFFERENTIAL CROSS SECTIONS FOR TRITIUM-INDUCED REACTIONS ON C^{12}. G. D. Gutsche, H. D. Holmgren, L. M. Cameron, and R. L. Johnston (U. S. Naval Research Lab., Washington, D. C.). Phys. Rev., 125: 648-55(Jan. 15, 1962).

Differential cross sections for the ground-state proton group from the $C^{12}(t,p)C^{14}$ reactions, and for the ground-state and first-excited-state alpha groups from the $C^{12}(t,\alpha)B^{11}$ reactions, were studied as functions of the angle of emission and the bombarding energy at 0.800 to 2.025 Mev. Elastically scattered tritons were also studied at 1.000 to 1.950 Mev. The angular distributions of all reaction groups are complex. The basic structure of the angular distributions for the ground-state alpha group is retained throughout the energy region studied; however, it shifts toward higher angles with increasing bombarding energy. The structures of the angular distributions for the first-excited-state alpha group and the ground-state proton group shift smoothly toward lower angles with increasing energy. The first-excited-state alpha group exhibits a resonance at 1.13 Mev at which the total cross section increases by a factor of 4. The width of this resonance is about 50 kev. Angular distributions of this group are not

affected by the resonance, and the effects of this resonance are negligible in the other reaction channels. Total cross sections for all of the reaction groups increase rapidly between 1.5 and 1.7 Mev. This increase may be partially due to a broad anomaly in the region of 1.8 Mev. The total cross sections for the ground-state and first-excited-state alpha groups at 1.95 Mev are 330 and 30 mb, respectively. The $C^{12}(t,\alpha)B^{11}$ reactions may proceed by a "direct cluster exchange interaction" in which the distortion effects may play an important part. (auth)

9465 DECAY OF Se^{75} AND THE LIFETIME OF THE 280-kev STATE OF As^{75}. J. Varma and M. A. Eswaran (Atomic Energy Establishment, Trombay, India). Phys. Rev., 125: 656-59(Jan. 15, 1962).

The decay of 120-day Se^{75} was investigated using the NaI(Tl) scintillation spectrometer and coincidence technique. Intensities of the electron capture transitions to the 403-, 572-, and 628-kev states of As^{75} are found to be in the ratio of $1 : 5.3 \times 10^{-4} : 2.4 \times 10^{-4}$. On the basis of log ft values of the β and electron-capture transitions, the spins and parities of the 477, 572, 628, and 814-kev states of As^{75} are assigned as $\frac{1}{2}^-$, $\frac{5}{2}^-$, $\frac{1}{2}^-$, and $\frac{5}{2}^-$ (or $\frac{7}{2}^-$), respectively. Employing the delayed coincidence method and a time-to-pulse-height converter, the mean lifetime of the 280-kev state is measured as 7.8×10^{-10} sec. The partial E2 lifetimes for the 265- and 280-kev levels are estimated to be 1.1×10^{-9} and 5.2×10^{-9} sec, respectively. (auth)

9466 DOUBLET SPLITTING IN THE 1p SHELL DUE TO TENSOR INTERACTION. Paul Goldhammer (Univ. of Nebraska, Lincoln). Phys. Rev., 125: 660-4(Jan. 15, 1962).

The separation of $p_{3/2}$ and $p_{1/2}$ orbitals in N^{15} due to the tensor force was estimated using second-order perturbation theory. The estimated splitting of 5.6 Mev is to be compared with an experimental separation of 6.3 Mev. General relationships needed in computing the doublet splitting due to tensor interaction in nuclei with a closed shell plus or minus one nucleon are developed. (auth)

9467 NUCLEON AND NUCLEAR CROSS SECTIONS FOR POSITIVE PIONS AND PROTONS ABOVE 1.4 Bev/c. Michael J. Longo and Burton J. Moyer (Univ. of California, Berkeley). Phys. Rev., 125: 701-13(Jan. 15, 1962). (UCRL-9497(Rev.))

Total (π^+,p) and (p,p) cross sections in the momentum range 1.4 to 4.0 Bev/c are presented. These measurements, with an accuracy of approximately 2%, were made at the Berkeley Bevatron by using counter techniques. Pions were distinguished from protons by means of a gas-filled Cherenkov counter. The (π^+,p) total cross section was found to be almost constant above 2.0 Bev/c at a value near 29 mb. The (p,p) cross section decreases gradually from 47.5 mb to 41.7 mb over the momentum range covered. Transmission measurements of π^+-nucleus and p-nucleus cross sections in both good and poor geometry were made at 3.0 Bev/c. Results are compared with the predictions of the optical model. An essentially exact solution of the wave equation for a potential well with a diffuse edge was used. The values of the imaginary part of the optical potential that best fit the experimental data are in good agreement with the predicted values. No strong conclusion regarding the real part of the potential was possible. Absorption and total elastic scattering cross sections for Be, C, Al, and Cu are presented. (auth)

9468 MUTUAL EXCITATION VIA A TWO-PHONON SURFACE INTERACTION IN $C^{12}(C^{12}, C^{12*})C^{12*}$. G. T. Garvey, A. M. Smith, J. C. Hiebert, and F. E. Steigert (Yale Univ., New Haven). Phys. Rev. Letters, 8: 25-7 (Jan. 1, 1962).

C^{12} inelastic interactions $C^{12}(C^{12}, C^{12*})C^{12*}$ were studied. A single phonon of excitation was observed in each resulting nuclei. Measurements of angular distributions were made, and agreement with theoretical calculations was obtained. Possibilities for the occurrence of such phenomena in other reactions are discussed. (L.N.N.)

9469 NUCLEAR MAGNETIC RESONANCE IN METALS. T. J. Rowland (Union Carbide Metals Co., Niagara Falls, N. Y.). Progr. in Materials Sci., 9: 1-91 (1961).

A review is given of the experimental results and theory of nuclear magnetic resonance as they pertain to metals. There are 217 references from which information was obtained. Sections give such information as features of experimental techniques; quantities measured in or derived from resonance experiments; mechanisms responsible for the position, width, shape, and intensity of observed nuclear resonance absorption lines; and where and when the nuclear magnetic resonance method can be used. (N.W.R.)

9470 EFFECT OF CHARGE POLARIZATION ON THE INTERACTION OF HEAVY IONS. Kōsuke Nakamura (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 26: 426-8(Sept. 1961). (In French)

The effects of charge polarization in the pure Coulomb interaction of two nuclei are examined. Empirical data are used where possible in order to avoid the ambiguity encountered in the use of nuclear models and nuclear wave functions. To a second order approximation, the relations between the dipole matrix element and the photonuclear cross section, and between the quadrupole matrix element and the mean radiative lifetime, may be combined to give the expectation value of the system's potential energy. Calculations are performed for the systems O^{16}-O^{16}, C^{12}-C^{12}, and O^{16}-U^{238}. The expectation value may also be calculated by replacing the matrix elements with the data on electron scattering, after applying the closure approximation. (T.F.H.)

Particle Accelerators

9471 (INSJ-43) NEW MAGNETIC PICK-UP PROBE FOR CHARGED PARTICLE BEAMS (FEEDBACK-TYPE INDUCTION PROBE). Ryuji Yamada (Tokyo Univ. Inst. for Nuclear Study). Nov. 3, 1961. 31p. (TH-41)

A new magnetic pick-up probe of feedback type to measure the total intensity of charged particle beams was designed and successfully applied to a linac beam. A beam is passed through the window of a magnetic core and is detected and amplified by a pick-up coil wound on the core. The current generator feedbacks negatively this amplified signal to another coil wound on the same core. The voltage generated across a resistor with this feedback current is proportional to the passing beam and serves as a measure of the beam intensity. For a beam of 1 ma, the output voltage can be made to 1 volt, and the time constant can be varied for different beams. This probe is superior to other magnetic probes and also to electrical probes. (D.L.C.)

9472 (INSJ-46) ASSEMBLY AND SETTING OF INS 1-Bev ELECTRON SYNCHROTRON MAGNET. Ryuji Yamada (Tokyo Univ. Inst. for Nuclear Study). Dec. 15, 1961. 32p. (TH-42)

Techniques applied in construction of the supporting base of the synchrotron and in assembling and positioning the various parts of the synchrotron proper (magnet base, yoke, coil, and pole pieces) are reviewed. Changes in positioning as a result of settling over a period of years are examined. (T.F.H.)

9473 (JINR-P-811) REZONANSNYI VYSOKOCHASTOTNYI RAZRYAD V TSIKLOTRONE. (Resonance High Frequency Discharge in a Cyclotron). B. A. Zager and V. G. Tishin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. for Nuclear Reactions). 1961. 20p.

A mechanism and conditions for the existence of the low-voltage resonance high-frequency discharge multipactor effect are considered. The effect of this mechanism on the cyclotron operation is treated both for the supply from the high-frequency generator with independent excitation and for the self-oscillation system. The appearance of the plasma high-frequency discharge in the cyclotron is attributed to the multipactor effect which is confirmed by the experience gained during the adjustment and operation of the Joint Institute multiple-charged ion cyclotron. (auth)

9474 (MURA-466) IMAGE FORCES IN THE THIRD MURA MODEL. J. Van Bladel (Midwestern Universities Research Assn., Madison, Wis.). June 12, 1959. Contract AT(11-1)-384. 15p.

The electric and magnetic fields which exist around the 50A beam are investigated. These fields are strongly influenced by the presence of the vacuum tank and of the magnetic circuit. (auth)

9475 (MURA-510) THE DISPLACEMENT RF SYSTEM OF THE WISCONSIN MODEL. Robert Stump (Midwestern Universities Research Assn., Madison, Wis.). Sept. 8, 1959. Contract AT(11-1)-384. 8p.

Operation of the circuits is described which make up the r-f system that provides energy to the stacked beam by phase displacement. (auth)

9476 (TID-13715) SHIELDING DESIGN OF THE CAMBRIDGE ELECTRON ACCELERATOR. R. W. Williams (Cambridge Electron Accelerator, Mass.). Aug. 31, 1956. Contract [AT(30-1)-1909]. 12p. (CEA-10(MH))

The shielding design for the Cambridge Electron Accelerator is described. Tolerances, source strength, mean free paths, source locations, and predicted levels are discussed. (M.C.G.)

9477 (TID-13716) MAGNET CONSTRUCTION AND ASSEMBLY. M. S. Livingston (Cambridge Electron Accelerator, Mass.). June 25, 1957. Contract [AT(30-1)-1909]. 14p. (CEA-36(MH))

The present status of plans for construction of the laminated magnet sectors is summarized. Magnet model measurements gave preliminary values of all magnet specifications and parameters, confirming the validity of the basic design. Assembly sketches of the method of mounting two half-sectors on a box girder supported by piers at the ends were also completed. The time schedule for construction, spares and wastage allowance, punching dies, lamination bonding, sorting and stacking, assembly mandrel and clamping jig, assembly and clamping, thermo-bonding of resin, removal from mandrel, assembly of magnet units, and installation in tunnel are discussed. (M.C.G.)

9478 (TID-13721) SHAPED DRIFT TUBES AND IRISES IN LINEAR ACCELERATORS. Yale Study on High Intensity Proton Accelerators. Internal Report Y-4. R. L. Gluckstern (Yale Univ., New Haven). Sept. 1961. Contract [AT(30-1)-2726]. 26p.

A method previously developed to obtain the parameters, fields, and losses for linear accelerator cells loaded with shaped drift tubes was used for those shapes generated by a two-charge pair located on the axis of the cell. The application of the method to π-mode iris loaded cells is discussed and numerical results are given. (M.C.G.)

9479 (TID-13956) MINUTES OF THE MURA GENERAL CONFERENCE, MADISON, WISCONSIN, DECEMBER 2-3, 1960. No. 119. (Midwestern Universities Research Assn., Madison, Wis.). Contract AT(11-1)-384. 41p.

Design and development of a 15-Bev FFAG accelerator and a 5-Bev FFAG-injection AGS are reviewed, with respect to orbit theory, magnet systems, r-f systems, injection systems, engineering aspects, experimental uses, and associated problems. The construction and theory of a 40-Mev electron model for an accelerator are outlined. The design of a 30-in.-diam × 15-in.-long bubble chamber is reviewed. The operation of the Brookhaven AGS is discussed. (T.F.H.)

9480 (TID-14224) SHOWER DEVELOPMENT AND HEATING IN THE ACCELERATING STRUCTURE OF A 50-BEV LINEAR ELECTRON ACCELERATOR. J. J. Muray (Stanford Univ., Calif.). Sept. 1961. Contract AT (04-3)-363. 30p. (M-276)

An estimate is given of the axial and radial temperature gradients in the accelerating structure of the Stanford two-mile accelerator if a fraction of the 60-μamp average beam-current at various energies up to 50 Bev strikes the structure. It is concluded that high-energy electron collisions in the accelerating waveguide structure start a series of high-energy interactions which heat the structure and give rise to penetrating radiation. The temperature gradient can be decreased by using collimators between the waveguide sections and protection can be afforded by a fast interlock system. (J.R.D.)

9481 (TID-14856) KLYSTRON BUNCHING OF A POSITIVE ION BEAM (thesis). William L. Schrader (Vanderbilt Univ., Nashville, Graduate School). June 1958. 44p.

A method of producing short ion bursts using a klystron type buncher was investigated. In this method the bunching voltage is applied prior to acceleration of the ions. Basic klystron bunching, bunching applied to an ion current, the Applegate diagram, and mathematical treatment of the klystron bunching theory are discussed. The mechanical bunching assembly, the bunching oscillator circuitry, the ion source and assembly, the vacuum system, and the current collector and analysis system are described. A large signal was imposed on the collector by the two radiofrequency voltages used in the system. The ion pulse appeared only as a superimposed blip on a 3-megacycle sinusoidal signal. Several methods were tried to reduce the interference of the radiofrequency signals with little success. (M.C.G.)

9482 (AEC-tr-4986) NONLINEAR RESONANCES IN ELECTRICAL MASS FILTERS AS A CONSEQUENCE OF FIELD ERRORS. F. v[on] Busch and W. Paul. Translated for Oak Ridge Gaseous Diffusion Plant, Tenn. from Z. Physik, 164: 588-94(1961). 12p.

Deviations from the ideal space-time course of the quadrupole field in the electrical mass filter cause nonlinear resonances of the ion movements with certain values of the field parameter, because of factors analogous to the stop bands in the case of cyclotrons with alternating field gradients. Sufficiently strong interferences result in a decrease in the intensity of the stabilized ion beam. Various field errors are discussed with respect to the theoretically possible resonances and results are compared with experimental observations. (auth)

9483 (NP-tr-829) THE LIMITATION OF PARTICLE CURRENT IN A LINEAR ACCELERATOR WITH QUADRU-

POLE FOCUSING. A. D. Vlasov (Akademiya Nauk S.S.R. Radiotekhnicheskii Institut). Translated by E. S. Carter (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.). Sept. 1961. 22p.

The question of the upper limit of particle current in a proton or ion linear accelerator with quadrupole focusing is examined. The condition of stability of phase oscillations is shown to restrict the possible current to a fairly low value, on the order of some tens of milliamperes. However, when the current is raised up to this limit, focusing conditions are actually easier than with a negligibly small current and full use of the capture angle. (D.L.C.)

9484 PROPOSAL FOR AN ELECTRON ACCELERATOR USING AN OPTICAL MASER. Koichi Shimoda (Tokyo Univ.). Appl. Optics, 1: No. 1, 33-5(Jan. 1962).

Application of the extremely high brightness temperature and radiation density obtainable with the optical maser, to produce a high energy electron accelerator, is proposed and discussed. The accelerator consists of a cylindrical tube of maser material excited by a pumping radiation through an interference filter coated on its outer surface, and it generates an oscillation in a TM_0NM type mode. An optical peak power of 10 kw/cm^2 is calculated to accelerate electrons by 10^9 ev/meter. A gas-filled cavity is proposed for velocity matching. Selection of the desired mode might be made by placing a periodically printed absorption layer on the inner surface on the maser cylinder. However, mode separation would be extremely difficult because of thermal expansion of the maser material. (auth)

9485 HIGH CURRENT COCKCROFT ACCELERATOR MODIFIED BY THE USE OF ROTARY SWITCH DEVICES. T. Sakamoto and S. Ota (Nissin Electronic Co., Ltd., Kyoto). Atompraxis, 8: 20-4(Jan. 1962). (In English)

In order to meet the need of radiation industries for a high power, low cost radiation source, a 2 Mev, 3 ma rating electron accelerator was developed. A d-c power supply is combined with rotary switches instead of an a-c power supply and Cockcroft-Walton rectifiers, though the characteristics of both types are almost identical. A brief summary of the equipment is given, along with a description of various kinds of high voltage techniques, and the design and method of conditioning of the tube, and a comparison with other radiation sources. (auth)

9486 40 Mev LINEAR ACCELERATOR FOR A GERMAN ELECTRON SYNCHROTRON. Engineer, 213: 115-18 (Jan. 19, 1962).

A 40 Mev linear accelerator is described that is to serve as the electron injector for the 6 Bev electron synchrotron at Hamburg, Germany. Acceptance tests on the accelerator show that its output beam has a divergence within ± 0.25 milliradian and that 90% of the electrons in the beam will pass through a hole 9 mm in diameter. A beam current of 250 ma can be produced at a mean energy of 44 Mev. The specified requirement for 125 ma of electrons having energies within $\pm \frac{1}{2}\%$ of the mean energy can be attained with a total beam current less than 160 ma. The maximum permissible energy deviation from 40 Mev is ± 0.2 Mev. Schematic diagrams are presented of the radio-frequency system and the modulator. (N.W.R.)

9487 ELECTRON OPTICS IN ACCELERATING TUBES. Minoru Morikawa (Nissin Electric Co., Ltd., Kyoto). J. Appl. Phys., 33: 87-90(Jan. 1962).

Focusing properties of the multi-stage system of weak lenses, as in the accelerating tubes, are considered. The lens system is treated as one thick lens in the paraxial ray approximation. Assuming that the field distribution of each lens is the same, the simple expressions for the focal lengths and the locations of the focal points of this lens system as a whole are given. (auth)

9488 THE MAIN BUILDING FOR THE 7 G ELECTRON-VOLT PROTON SYNCHROTRON AT HARWELL. Stanley Albert Rossiter (Merz and McLellan, London) and John Stewart Brown. Proc. Inst. Civil Engrs. (London), 20: 259-74(Oct. 1961).

The proton synchrotron itself and its function are described only where this is necessary for an appreciation of the associated foundation and structural problems. The rigorous permissible limits of settlement and distortion of the supports for the machine are indicated, together with the very heavy radiation shielding required. The general arrangement of the buildings for the project is indicated. A more detailed account is given of the main underground building which includes a room 200 ft in diameter. Heavy load concentrations are entailed, with 6,000 tons of removable shielding. The development of the design of the building on a yielding chalk foundation is described resulting in the choice of two monoliths to carry the loads, supplemented by a complex of heavily loaded ancillary structures; these include an unusual two-span reinforced concrete bridge with a solid steel central pier and a copper bearing. (auth)

9489 THE AUXILIARY BUS BARS OF SATURNE. René Rols. Rev. aluminium, No. 292, 1277-87(Nov. 1961). (In French)

Discussion is given on the Saturne proton synchroton with a 3 Bev power for which various experimentation devices such as magnets and bubble chambers were built. The supply of these large power consumers required the erection of a set of auxiliary bus bars, rectifiers, and rotating converters to many tap-off enclosures. This very particular busway involved the use of 40 tons of aluminum conductors. (auth)

9490 LIMITATIONS OF ACCELERATOR MAGNETIC ANALYZING SYSTEMS. Bernard L. Cohen (Univ. of Pittsburgh). Rev. Sci. Instr., 33: 85-92(Jan. 1962).

The relationship between the best resolution obtainable with an accelerator magnetic analyzing system and the rate at which reaction product particles are received at the detector is studied. For cyclotrons and linear accelerators (but not for Van de Graaffs), the beam from the accelerator in all ordinary cases more than fills the phase space volume accepted by the analyzing system; the optimum resolution depends on the phase space density of the accelerator beam to the 1/6.5 power. For Van de Graaffs, the optimum resolution depends on the total accelerator current to the 1/2.5 power. For all typical cases with all accelerators, the best obtainable resolution, for situations where good resolution is needed from the nuclear physics standpoint, is between 3 and 10 kev. AVF cyclotrons should obtain about the same resolutions as Van de Graaffs, but with more difficulties in alignment and stability. (auth)

Plasma Physics and Thermonuclear Processes

9491 (AFOSR-1521) INITIAL BREAKDOWN OF GASES IN ELECTRODELESS DISCHARGES. Final Report. H. G. Loos (Giannini Scientific Corp., Santa Ana, Calif.). Sept. 1961. Contract AF49(638)-1014. 7p.

Theoretical studies on the initial breakdown phenomena in a long cylindrical column of slightly preionized gas that

is subjected to a strong, fast-rising axial magnetic field are discussed, as are corresponding experimental observations on cylindrical and toroidal configurations. The magnetic field is initially zero. (T.F.H.)

9492 (AFOSR-1522) IONIZATION IN AN ELECTRODELESS DISCHARGE. PART II. R. P. Treat (Giannini Scientific Corp., Santa Ana, Calif.). Sept. 1961. Contract AF49(638)-1014. 49p.

A discharge is produced in a long cylindrical column by a fast-rising, strong, axial magnetic field. The gas begins to ionize near zero magnetic field, and continues until the field becomes large enough to quench the ionization. The theoretical voltage needed to increase the ionization fraction by a given amount is compared with experimental breakdown voltages. The behavior of the electric field during ionization is such that breakdown can occur only in the outer layers of the gas; thus breakdown causes the formation of a luminous sheath in these layers. The properties of this sheath are studied. (T.F.H.)

9493 (AFOSR-1523) IONIZATION EXPERIMENT ON AN ELECTRODELESS DISCHARGE IN A CYLINDRICAL COIL. H. G. Loos and R. P. Treat (Giannini Scientific Corp., Santa Ana, Calif.). Aug. 1961. Contract AF49(638)-1014. 31p.

The breakdown of argon and air was studied for an electrodeless discharge in a straight cylindrical coil. No evidence of deviations from axisymmetry of the discharge due to the coil junction was found. A luminous sheet formed in all discharges, including the ones with marginal voltages. Simultaneous smear pictures and oscillograms of (dB/dt) support the assumption that the luminous sheet is a current sheet. The initial breakdown was always accompanied by a sudden reduction of (dB/dt) inside the gas. (auth)

9494 (AFOSR-2144) THE WAVE MOTIONS OF SMALL AMPLITUDE IN A FULLY IONIZED PLASMA. PART IV. WITH AN ARBITRARY APPLIED MAGNETIC FIELD. D. G. Weir (Maryland. Univ., College Park). Jan. 1962. Contract AF49(638)40. 26p. (BN-271)

The dispersion relation of waves in a fully ionized plasma under a uniform magnetic field of arbitrary orientation is derived from two-fluid theory which is a quartic equation for λ^2, λ being the complex wave number. Various cases are examined. It is shown that the roots for λ^2 are all real for an ideal plasma. In the low-frequency range three of the roots for λ^2 are positive, corresponding to undamped waves, while one root is negative, leading to a damped exponential wave. One of the positive roots changes into a negative root at frequencies higher than the ion cyclotron frequency, calculated from the component of magnetic field in the direction of the wave propagation, and another root changes sign when the frequency becomes higher than the electron cyclotron frequency calculated for the same component of the magnetic field. At very high frequencies, all four roots are positive. The interaction between basic waves due to external magnetic field at very high frequencies is negligible. (auth)

9495 (CLM-R-13) ON THE INFLUENCE OF A UNIFORM CURRENT ON HYDROMAGNETIC WAVES. L. C. Woods (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Abingdon, Berks, England). Oct. 1961. 26p.

An axial magnetic field passes through a partially ionized cylindrical plasma. With no steady current flowing, hydromagnetic waves of frequency $\omega/2\pi$ move along the axis with phase velocity v_{p_0}. A theory was developed showing that if in addition a steady uniform, axial current flows along the plasma, the wave velocity becomes: $v_{p_0} = \{1 + \alpha \delta v_{p_0}/\omega\}$, where $\frac{1}{2}\delta r_0$ is the ratio of the azimuthal field due to the current to the axial field at radius r_0 and the coefficient α is, in general complicated function of the various plasma characteristics. At frequencies well below the ion-cyclotron frequency (ω_{ci}), $\alpha = m$, where m is an integer indicating the aximuthal dependence of the wave. If m is zero, and the frequency is greater, α is found to be proportional to the ratio ω/ω_{ci}. (auth)

9496 (D1-82-0131) SOME REMARKS CONCERNING ELECTRON PLASMA WAVES. Richard A. Gerwin (Boeing Scientific Research Labs., Seattle). Nov. 1961. 80p.

The general initial value solution to Maxwell's solutions was derived for a cold uniform plasma. Dispersion relations were derived for certain non-planar longitudinal plasma waves, and dispersion relations are compared for planar transverse waves in the case of frequent and infrequent electron-electron close collisions. A dispersion relation was derived for the longitudinal oscillations of an electron beam. The effect of an ion wave on small-amplitude electron plasma waves is examined. (D,L,C.)

9497 (D1-82-0146) EXPERIMENTAL TWO-BEAM EXCITATION OF PLASMA OSCILLATIONS. M. J. Kofoid (Boeing Scientific Research Labs., Seattle). Dec. 1961. 33p.

Plasma electron oscillations were excited in experiments in which the essential conditions of the Bohm and Gross two-beam theory were reasonably fulfilled. They predicted that in a one-dimensional plasma, oscillations should be excited by oppositely directed electron streams of well-defined velocity passing through a positive ion background, with the ions compensating the charge in the beams in the absence of oscillations. In the experiments, independent interpenetrating electron beams were passed through a plasma of much higher charge density; in traveling through the plasma, the beam electrons ionized neutral atoms and thereby produced sufficient positive ions to compensate their own charge to a reasonably high degree. With boundary electrodes present, standing waves of longitudinal plasma electron oscillations were produced. It was established that, in agreement with theory, no velocity modulation of the beam electrons prior to their entering the plasma was needed in order to cause the build-up of large-amplitude oscillations. This matter was given particular attention and tests were made with apparatus designed specifically to avoid such modulation. Standing waves were detected when the ratio of the phase velocity to the beam electron velocity had the value of $k + \frac{1}{4}$ or $k + \frac{3}{4}$, where k was a small whole number; it was not necessary for the beams to have equal velocities. (auth)

9498 (LAMS-2651) CONTROLLED THERMONUCLEAR RESEARCH PROGRAM QUARTERLY STATUS REPORT OF THE LASL FOR PERIOD ENDING NOVEMBER 20, 1961. (Los Alamos Scientific Lab., N. Mex.). Dec. 1961. Contract W-7405-Eng-36. 14p.

Measurements of the coaxial gun output, the injection process, and characteristics of the trapped plasma were continued in the Mark II (Bakeable Picket Fence) experiment. Results and discussion are also included on the Caulked Picket Fence and Resonant Helix experiments. Development of a new principle for building fast magnetic coils is reported. The coils have no feed point asymmetry and are capable of voltage multiplication from the energizing capacitor bank to the plasma. Other work is

reported on plasma experiments without applied electric fields, and on development of capacitor bank systems. (J.R.D.)

9499 (MATT-1(3rd Ed.)) CUMULATIVE LISTING OF PLASMA PHYSICS LABORATORY REPORTS AND PUBLICATIONS. (Princeton Univ., N. J. Plasma Physics Lab.). Nov. 22, 1961. Contract AT(30-1)-1238. 35p.

A complete listing of reports and publications issued by the Princeton University Plasma Physics Laboratory from its inception in July 1951(under the name of Project Matterhorn) through November 1961 is presented. The references are arranged under the following headings: PM-S-reports, publication numbered reports, technical memoranda, PM periodic status reports, quarterly reports, MATT reports, and miscellaneous journal publications. (M.C.G.)

9500 (MATT-Q-17) [PROJECT MATTERHORN] QUARTERLY REPORT COVERING THE PERIOD OCTOBER 1–DECEMBER 31, 1961. (Princeton Univ., N. J. Plasma Physics Lab.). Jan. 29, 1962. Contract AT(30-1)-1238. 42p.

Progress is reported on experimental physics, engineering and development, and theory. A preliminary study was made of the impurity level in the C stellarator during ohmic heating. A helical winding was installed in one U-bend of Model C. In B-66 detailed measurements were made on wave propagation at frequencies much exceeding the ion cyclotron frequency. The effect of finite gyration radius on the stability of plasma in a stellarator was computed on an idealized model. Attempts were made to excite longitudinal ion waves in the afterglow of B-1. Electrostatic probes were used to determine the electron temperature and plasma density distribution in B-3. The Langmuir-probe measurements on Etude are summarized. Operation was transferred to the Etude Replacement. Beam-plasma experiments were carried out. A sodium plasma was produced in a small test assembly. From magnetohydrodynamic equations, the dispersion relation for electrostatic waves propagating nearly at 90° to the magnetic field was derived. Further study was made of plasma transmission through a 90° bend in a magnetic field to determine the source of neutralization of the polarization field. Changes in motor generator sets, coils, electronics, and instrumentation are described. (M.C.G.)

9501 (NP-11335) EQUIPMENT FOR MEASURING THE LIGHT EMISSION IN DISINTEGRATING GASEOUS PLASMAS. Period Covered: July 1960 to July 1961. R. A. Gerber and H. J. Oskam (Minnesota. Univ., Minneapolis). Contract Nonr-710(37). 41p.

The time dependence of the intensity (I) of spectral lines emitted during the disintegration period of a pulsed discharge is studied, as an aid to the interpretation of phenomena occurring during the afterglow period. A survey is given of the various collision processes that can lead to the emission of light during the afterglow period. The equipment used for this type of studies is described. Measurements on afterglows in He show that the spectral line intensity range for which measurements can be made is at least from I_0 to $I_0 \times 10^{-4}$ (I_0 = initial intensity), for the most dominant spectral lines. (auth)

9502 (ORNL-3232) DISSOCIATION AND IONIZATION OF H_2^+ BY ELECTRONS AND PROTONS. R. G. Alsmiller, Jr. (Oak Ridge National Lab., Tenn.). Jan. 24, 1962. Contract W-7405-eng-26. 20p.

The cross section for the dissociation and ionization of the H_2^+ molecule by electrons and protons is calculated using a method introduced by M. Gryzinski. (auth)

9503 (ORNL-3239) THERMONUCLEAR DIVISION PROGRESS REPORT, FEBRUARY 1, 1961–OCTOBER 31, 1961. (Oak Ridge National Lab., Tenn.). Jan. 24, 1962. Contract W-7405-eng-26. 113p.

Included are summaries of studies of: DCX-1 operation and performance; DCX-2 design and engineering; plasma physics; vacuum arcs; ion production, acceleration, and injection; plasma theory and computations; magnetics; and vacuum system techniques. Separate abstracts were prepared for the eight sections. (B.O.G.)

9504 (ORNL-3239(p.1-9)) DCX-1 PLASMA EXPERIMENTS. C. F. Barnett, J. L. Dunlap, et al. (Oak Ridge National Lab., Tenn.).

A new source featuring preanalysis of the ion beams now permits the injection of up to 10 ma of H_2^+. Modifications to the apparatus, primarily the addition of pumping by titanium films deposited on surfaces cooled by liquid N_2, reduced the operating pressure in the presence of this beam to about 1×10^{-8} Torr. With gas dissociation, fast protons were trapped at densities of about 10^8 per cm^3 (corresponding to a 9-ma beam); the mean proton lifetimes were in excess of 5 sec, and charge exchange was the dominant loss mechanism. Studies with currents from 0.2 to 9 ma have shown no dependence of proton lifetimes on the injected current. Studies of r-f signals from the plasma region were extended to include analyses of the first four harmonics of the cyclotron radiation. Further stabilization of the 600-kv power supply allowed beam turn-on studies at the higher injected currents, and the responses of the r-f signals and of the neutral-particle detectors were measured during plasma buildup. A lithium-ion beam probe for determining plasma potentials was developed and used to measure the potential of the DCX-1 plasma as a function of pressure and injected current. A discussion of observations pertaining to DCX-1 instability is included. (auth)

9505 (ORNL-3239(p.10-15)) DCX-2. P. R. Bell, J. S. Culver, et al. (Oak Ridge National Lab., Tenn.).

Construction of the DCX-2 apparatus is almost complete. The magnet coils were tested for strength and adequacy of cooling with satisfactory results. The accelerator was installed and found to hold its full 600 kv in the presence of the stray magnetic field. Tests of a scale model of the injection channel showed the expected magnetic shielding capability and suggested that perturbation of the external field will not be serious. Low-density lithium and deuterium plasmas are being developed for use as trapping plasmas. The vacuum system, which will make use of the ion-pumping action of the trapped plasma, has several novel features which are described. (auth)

9506 (ORNL-3239(p.16-46)) PLASMA PHYSICS. R. A. Dandl, H. O. Eason, et al. (Oak Ridge National Lab., Tenn.).

Studies are continuing on the plasma formed by heating electrons at the cyclotron frequency (3-cm, 0.75-kw microwave source) in a magnetic-mirror configuration. Two distinct regimes of operation are demonstrable: a low-pressure regime (5×10^{-6} mm Hg) in which the density ranges from 10^9 to 10^{10} particles/cm^3 and the electron temperature is greater than 0.1 Mev; and a high-pressure regime (10^{-5} mm Hg) in which densities are greater than 10^{12} particles/cm^3 and electron temperatures are about 5 kev. This plasma is very highly ionized, as evidenced by neutral-beam-transmission experiments. Determinations of energy density and temperature were made in the two regimes. Results and techniques are described. The original evidence concerning the existence

of ionic sound waves is supported by subsequent experiments. They are more completely investigated in mode 1 arcs. An addition and correction to a recent paper by F. W. Crawford on ionic sound waves in discharge tubes is discussed. Ionic sound waves are shown to occur in a spherical discharge tube in the absence of an applied magnetic field. The axial pressure exerted by a magnetically confined plasma is measured and used to determine the electron temperature or density. A new method of measuring the average ion density in magnetically supported plasmas is discussed. This method, called the "plasma sweeper," may perhaps measure ion temperature and the ion velocity and density distributions. The method is applied to a volume of plasma formed at the intersection of an electron stream and a gas jet. The results imply turbulence in the plasma which increases with increasing magnetic field strength. The effect of adding magnetic mirrors to further contain the plasma is reported. (auth)

9507 (ORNL-3239(p.47-63)) VACUUM ARC RESEARCH. M. R. Skidmore, J. R. McNally, Jr., et al. (Oak Ridge National Lab., Tenn.).

Ion temperatures in an 84-in. magnetically confined carbon arc are about 1,400,000°K at a point 72 in. from the anode. The line profile of λ4647 A of C^{2+} is Gaussian, suggesting that thermalization of these ions does exist. High-resolution spectroscopic studies revealed Doppler shifts (anode-to-cathode drifts and transverse precession) and broadening of Li^+ lines in the 120-in. solenoid. Electron excitation temperature, as measured from relative intensities of Li^+ lines, appears to be ~ 2 ev. No Li^{2+} lines were observed with certainty. Investigation of the high-vacuum deuterium arc plasma was oriented toward the measurement of basic properties, intercomparison of measuring techniques, and effects of parameter changes on the properties. The measurements were predominantly spectroscopic, supplemented by Langmuir-probe and microwave measurements. The properties investigated include ion and electron densities and temperatures, current oscillations, and cyclotron radiation. It is concluded that the plasma column is relatively quiescent and stable. (auth)

9508 (ORNL-3239(p.64-8)) ION PRODUCTION, ACCELERATION, AND INJECTION. R. C. Davis, R. R. Hall, et al. (Oak Ridge National Lab., Tenn.).

Further development of the injector system for DCX-2 is reported. The tube has been operated at a voltage of 700 kv, and has produced a mixed-ion beam of 100 ma at 650 kv, and 215 ma at 630 kv. At the upper current limit the external x-ray field causes voltage breakdown in the air around the tube. New electrodes with internal lead shielding were built to reduce this effect. Changes in electrode shape have greatly reduced cleanup time. The ion beam in the field-free region below the magnetic solenoid lens is self-space-charge neutralized. This effect was first observed in the 100-kv beam analysis facility when a magnetic solenoid lens was used. Such a lens permits electron trapping by the space-charge field of the beam. A hollow-cathode reflux-type arc discharge, which serves as ion source, was combined with an electron gun for a study of ion current output. The electrons are injected axially through the cylindrically symmetric ion source along lines of magnetic flux. Thermal power measurements of a 7-kv argon-ion beam output were made with and without electron injection. In the latter, ion currents are as expected under space-charge-limited operation. With electron injection, the target power goes up by a factor of 10, while power dissipated on the accelerating electrode goes up by a factor of only 2 to 3. (auth)

9509 (ORNL-3239(p.69-78)) THEORY AND COMPUTATION. Albert Simon, Norman Rostoker, et al. (Oak Ridge National Lab., Tenn.).

Topics discussed are as follows: Fokker-Planck coefficients for a plasma, including cyclotron radiation; the tritium breeding ratio in a fusion reactor blanket; the energy distribution of ions and electrons in DCX after burnout; the dissociation of H_2^+ by electrons and protons; instability in DCX-1; a possible approach to the mode I-mode II transition problem; stable plasmas; instabilities in a homogeneous anisotropic plasma; electrostatic ion-cyclotron plasma instabilities in a two-fluid hydrodynamic theory; reduction of the Vlasov equation; and calculations of H_2^+ orbits in the dip region of DCX-2. (auth)

9510 (ORNL-3239(p.79-84)) MAGNETICS. W. F. Gauster, C. E. Parker, and G. R. North (Oak Ridge National Lab., Tenn.).

Optimization of superconducting solenoids is discussed with regard to both conductor volume and current distribution. The methods of optimization are illustrated. Calculations are made of the effect of dislocations of coils on the uniformity of the magnetic field that they produce in iron-free configurations. Lateral, angular, and axial displacements are treated, as well as current changes. (auth)

9511 (ORNL-3239(p.85-95)) VACUUM SYSTEMS AND TECHNIQUES. C. E. Normand, R. V. Neidigh, et al. (Oak Ridge National Lab., Tenn.).

Work is reported on getter pumping by vapor-deposited titanium films, calibration of ionization gages in magnetic fields, calibration of gages with different gases, and results of accelerated decomposition tests on some diffusion-pump oils. Results of energetic deuteron bombardment on titanium are presented, in which at normal incidence deuterons of 10 to 25 kev are found to give inappreciable sputtering. (auth)

9512 (ORO-500) PLASMA PHYSICS BULLETIN. VOLUME 1, 1961. (Miami. Univ., Coral Gables, Fla.). Sept. 1961. Contracts AT(40-1)-2454; AT(40-1)-2762; and AF19(604)-8082. 41p.

Included are three papers concerned with research on moving striations in glow discharge plasmas, transport properties in a rotating plasma, and arc studies in a magnetic field. Separate abstracts were prepared for each of the papers. (B.O.G.)

9513 (ORO-500(p.1-13)) MOVING STRIATIONS IN GLOW DISCHARGE PLASMAS. H. S. Robertson and M. A. Hakeem (Miami. Univ., Coral Gables, Fla.).

The dependence of moving striations on metastable atoms in the positive column plasma of a glow discharge was demonstrated by experiments in alkali metal vapors, which have no metastable states and no moving striations, and by experiments in inert gases, where the metastable population and the striation behavior can be greatly changed by the technique of irradiative depopulation. The metastable dependence seems so clearly demonstrated that the development of a more polished theory of striations is recommended. (B.O.G.)

9514 (ORO-500(p.14-24)) TRANSPORT PROPERTIES IN A ROTATING PLASMA. Harry S. Robertson (Miami. Univ., Coral Gables, Fla.).

An examination is made of the existence of an electromagnetic torque caused by the presence of friction and its consequent mechanical torque in a cylindrical rotating plasma in an axial magnetic field. It is concluded that if the classical diffusion theory is applicable to the physical situation in a plasma, it is possible for rotational motion to

exist steadily in the presence of friction; and that there may be a possibility of frictional forcing of the plasma cooperative modes causing enhanced diffusion. (B.O.G.)

9515 (ORO-500(p.25-39)) ARC STUDIES IN A MAGNETIC FIELD. William B. Pardo and Jack L. Tunstall (Miami. Univ., Coral Gables, Fla.).

A study was made of the phenomena known as the Neidigh pressure gradient arc, or Mode II, observed when electrons from heated filaments are accelerated by applied electric fields into a region into which gas is being introduced. Shielded probe measurements indicated time varying potentials in the region around the arc with peak-to-peak voltages on the order of the applied arc voltage, with frequencies from 20 to 100 kcps. Sputtering patterns and the radius of the observable glow indicated that high-energy ions were present in the arc. Measurements with a crossed-field velocity analyzer showed that the ions possess energies several times higher than would be expected from the applied arc voltages, and that the ion energies do not depend on the applied magnetic field. (B.O.G.)

9516 (PIBAL-645) RADIATION IN A PLASMA FROM A UNIFORMLY MOVING DISTRIBUTION OF ELECTRIC CHARGE. Manlio Abele (Brooklyn. Polytechnic Inst. Aerodynamics Lab., Freeport, N. Y.). Apr. 1961. Contract AF30(602)-2045. 35p. (RADC-TN-61-94; AD-257478)

Electromagnetic radiation cannot be emitted by a uniformly moving electric charge in a plasma in the absence of external magnetic fields, because the phase velocity of an electromagnetic oscillation in a plasma is larger than the velocity of light in a vacuum. Plasma oscillations may be emitted when the velocity of the moving charge is larger than the velocity of sound in the electron gas. The electron oscillations are analyzed and the spectral distribution of the radiated energy is evaluated, assuming a uniform linear distribution of moving charge. (auth)

9517 (PIBMRI-910-61) OPTICAL TECHNIQUES FOR CURRENT DENSITY MEASUREMENTS IN GASEOUS PLASMAS. Menachem Balfour (Brooklyn. Polytechnic Inst. Microwave Research Inst.). May 3, 1961. Contract AF30(602)-2149. 60p. (RADC-TN-61-124; AD-260041)

The development of an external measuring technique applicable to the determination of current density variations in a plasma is developed. This technique, utilizing suitably designed optical and electronic apparatus, introduces no secondary effects in the media being studied. A theoretical model relating light emanating from a gaseous plasma to its current density variations is used as a motivation for the development of the instrumentation. Experiments designed to test the feasibility of spatial, temporal, and spectroscopic resolution of the light output of a plasma in a manner consistent with the model are described. (auth)

9518 (UCRL-6585) STABILITY OF CYLINDRICAL PLASMAS FOR AXIAL PERTURBATION WAVELENGTHS LESS THAN THE RADIAL THICKNESS OF THE EQUILIBRIUM PLASMA. Alvin M. Saperstein (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 7, 1961. Contract W-7405-eng-48. 27p.

The perturbations of an azimuthally symmetric, collisionless plasma in static equilibrium with its self-consistent axial magnetic field were investigated. No assumptions of a fluid nature were made, and the collisionless Boltzmann equation was solved for disturbances giving no net radial current. A condition sufficient for stability was found for disturbances of the form $e^{i(\omega t+kz+l\theta)}$ where $l < kr$ and $2\pi/k$, the axial perturbation wavelength, is small compared to the thickness of the plasma. Although electrostatic forces were excluded in the derivation, a brief estimate indicated that the sufficiency condition retains its validity even when local neutrality is not assumed. (auth)

9519 (AEC-tr-4704) INTRODUCTORY REMARKS ON THE THEORETICAL PAPERS OF MAGNETOHYDRODYNAMICS. Translation of "Vstupitel'nye Zamecheniya k Teoreticheskim Dokladam po Magnitnoi Gidrodinamike." A. I. Akhiezer (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 4p.

The use of the theory of magnetohydrodynamics in the investigation of plasma is discussed. Investigations of the kinetic equation and a plan for the study of turbulence in plasma are also discussed. (M.C.G.)

9520 (AEC-tr-4723) INVESTIGATION OF HIGH-FREQUENCY OSCILLATIONS OF PLASMA PINCH OF A VACUUM ARC. A translation of "Issledovanie Vysokochastotnykh Kolebanii Plazmennogo Shnura Vakuumnoi Dugi." B. G. Safronov, R. V. Mitin, A. A. Kalmykov, and V. G. Konovalov (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 13p.

An investigation was made of the natural oscillations of the Luce arc which burns in a vacuum of 10^{-5} to 10^{-6} mm Hg between graphite electrodes. The different characteristics of the arc were determined. The visible pinch of the arc followed strictly the force lines of the magnetic field. Magnetic probers were used to study the high-frequency oscillations. The dependence of the oscillation frequency on the intensity of the magnetic field was determined. Measurements were made of the distribution of high-frequency fields inside the chamber. (M.C.G.)

9521 (AEC-tr-4727) MOTION OF FLEXIBLE CURRENT LOOP IN INHOMOGENEOUS MAGNETIC FIELD. A translation of "O Dvizhenii Gibkogo Tokovogo Vitka v Neodnorodnom Magnitnom Pole." K. D. Sinel'nikov, N. A. Khizhnyak, and B. G. Safronov (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 16p.

The unstable motion of current loops, both purely inductive and with allowance for ohmic losses, was investigated. The basic equation of motion of a current loop and the equations of motion of an inductive loop are given. It was calculated that the current loop, entering a linearly rising magnetic field, slows its motion down and, after covering a certain distance returns in the opposite direction. In a homogeneous external magnetic field, the current loop moves along the z axis with constant velocity and its radius changes as a result of the interaction between the current induced in it and the external and intrinsic magnetic fields. The equations of motion of a current loop in a magnetic field in the presence of an active resistance are in the form of integro-differential equations and admit principally of only a qualitative analysis. (M.C.G.)

9522 (AEC-tr-4728) PROPAGATION OF PLASMOIDS IN A FIELD-FREE SPACE. A translation of "Rasprostranenie Plazmenykh Sgustkov v Svobodnom ot Polei Prostranstve." K. D. Sinel'nikov, B. G. Safronov, I. T. Guzhovskii, and Yu. G. Yaremenko (Akademiya Nauk Ukr. S.S.R. Fiziko-Teckhnicheskii Institut). 1960. 23p.

The behavior of plasmoids in a space free of all fields was studied. The design of the plasma source is described. The propagation of the plasmoids was investigated in a vacuum chamber at a pressure of 10^{-5} to 10^{-6} mm Hg. The use of electric probes made it possible to investigate the properties of the source and plasmoids. From the form of the probe signal, conclusions could be drawn regarding the extent of the distribution of the particles in the plasmoid.

The volt-ampere characteristic was plotted to determine the potential necessary to break up the plasma. It was determined that the source produced two plasma formations, one fast and one slow, which were not related. The distribution of the excess charges of various polarities in a plasmoid was determined as a function of the distance between the axis of propagation and the probe. (M.C.G.)

9523 (AEC-tr-4732) CERTAIN PROBLEMS CONCERNING ACCELERATION OF PARTICLES IN A PLASMA. A translation of "Nekotorye Voprosy Uskoreniya Chastits v Plazme." Ya. B. Fainberg (Akademiya Nauk Ukr. S.S.R. Fiziko-Teckhnicheskii Institut). 1960. 21p.

The use of waveguides with direct focusing of the electromagnetic energy in the development of linear accelerators for high energies is discussed. A comparison is presented of plasma, metallic, and dielectric waveguides. The frequencies and amplitudes of the longitudinal and radial oscillations of the plasma waveguide were determined by integrating in the linear approximation the equations of motion of the accelerated particle in the plasma. Waveguides formed by a Brillouin uncompensated electron cloud, electron-ion beams, and an electron-positron plasma were considered as particle accelerators. The nonlinearity of the propagation of waves in plasma waveguides increased the effectiveness of the acceleration. (M.C.G.)

9524 (AEC-tr-4767) GYROTROPIC PROPERTIES OF A PLASMA IN THE PROPAGATION OF AN EXTRAORDINARY WAVE. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.) from "Girotrophnye Svoistva Plazmy Rasprostranenii Neobyknovennoi Volny." B. I. Patrushev, V. D. Rusanov, I. A. Kovan, V. V. Savichev, and D. A. Frank-Kamenetskii (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). 1960. 17p.

The rotation of a wave and polarization vector was experimentally observed during the propagation of an electromagnetic wave in a plasma at frequencies between the ion-cyclotron and electron-cyclotron frequencies. When the ion cyclotronic frequency was less than and the electron cyclotronic frequency greater than the frequency of the probing generator and a longitudinal magnetic field was present, propagation of a rotating electromagnetic field with circular polarization was found to be possible in a plasma wave guide. (M.C.G.)

9525 (CEA-tr-A-1016) ABSORPTION D'ÉNERGIE PAR L'HYDROGÈNE DANS LES DÉCHARGES ÉLECTRIQUES. (Absorption of Energy by Hydrogen in Electric Discharges). U. Grossmann-Doerth. Translated into French from German Report. [nd]. 29p.

A toroidal plasma is considered that is formed by the discharge of a capacitor that is inductively coupled to a toroidal container of gas. The discharge is assumed to produce 100% ionization in the gas, and a correspondingly very high temperature. A study is made of the gross behavior of the discharge, and of the assimilation of the energy by the gas under various conditions. Several simplifying assumptions are made (e.g., the pinch effect is entirely neglected). Calculations are shown for the case in which H_2 is the working gas. (T.F.H.)

9526 (FTD-TT-61-93) HOMOGENEOUS PLASMA TURBULENCE IN A STRONG MAGNETIC FIELD. M. M. Prudnikov. Translated from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk. Mekhan. i Mashinostr., No. 4, 10-13 (1961). 8p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 31731.

9527 (FTD-TT-61-113) FLOW OF ELECTRICALLY CONDUCTING GAS IN A CHANNEL WITH A TRAVELING MAGNETIC FIELD. E. P. Zimin and E. (Ye.) I. Yantovskii (Yantovskiy). Translated from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Mekhan. i Mashinostr., No. 4, 170-2(1961). 8p.

A discussion is presented of the problems associated with estimating the possibility of substituting for a bladed turbine a magnetogasdynamic device in which the thermal energy as it is liberated during burning is partially converted to mechanical or directly to electrical energy. Considerations are given for a steady flow of an ideal gas of finite conductivity in a channel of annular cross section with a radial magnetic field moving relative to the walls along the channel. Analyses of the solutions derived and the calculated estimates do not reject the possibility of developing magnetogasdynamic generators. (B.O.G.)

9528 (FTD-TT-61-196) STUDY OF NONEQUILIBRIUM PHENOMENA IN SHOCK WAVES. S. A. Losev and A. I. Osipov. Translated from Uspekhi Fiz. Nauk, 74: 393-434(1961). 84p.

A survey is presented of the basic methods and results from theoretical and experimental studies of the various relaxation phenomena in shock waves. A theoretical examination of equilibrium establishment according to individual degrees of freedom is made on the basis of the kinetic theory of gases. Results are included from experimental study of the state of the gas in shock waves. Applications of shock tubes in obtaining results on the kinetics of relaxation processes at high temperatures are considered. Only endothermic processes in gases are considered. (C.H.)

9529 (FTD-TT-61-282) A DUOPLASMATRON ION SOURCE. Translated from Elektrie, 15: No. 11, U121 (1960). 2p.

A duoplasmatron ion source is described which has an efficiency of almost 100% and which can be used in accelerators to deliver electron currents up to 7 amp at a density of 500 amp/cm^2. When fed H_2 gas, it delivers an ion stream of 1 amp from a 1.4-mm dia. aperture. (D.L.C.)

9530 (JPRS-11725) MAGNETOHYDRODYNAMIC SHOCK WAVES. Janos Szabo. Translated from Magyar Fiz. Folyoirat, 9: No. 1, 35-48(1961). 27p.

On the basis of fundamental magnetohydrodynamic equations, the conservation theorems are established with respect to an ideal plasma. The fundamental equations for magnetohydrodynamic shock waves are then derived for arbitrary discontinuity surfaces. It is proven that the magnetohydrodynamic shock waves are of the compression type, similar to gaseous dynamic shock waves. (auth)

9531 PROPAGATION OF L-F WAVES IN A PINCHED VISCOUS PLASMA ALONG A MAGNETIC FIELD. E. A. Ponomarev. Astron. Zhur., 38: 877-84(Sept.-Oct. 1961).

Consideration is given to a plane wave propagating in the direction of a magnetic field in a pinched viscous plasma an and having an amplitude lower than the magnetic-field intensity. The fluctuation of the plasma density is considered lower than the density fluctuation of unperturbed plasma and the effects of radiation and heat conductivity are ignored. Relationships generalizing the known magnetohydrodynamic equations are derived and the following conclusions reached: in a pinched viscous plasma the following waves may propagate along the magnetic field, depending on $V_0^2/\omega\vartheta$, where V_0 and ω are the wave velocity and wave frequency, respectively, and $\vartheta = (c^2/4\pi\sigma) + \nu$ (σ being the plasma conductivity and ν viscosity): magnetohydrodynamic and sound waves if $V_0^2/\omega\vartheta > 1$; viscous, sound, and radio waves if $V_0^2/\omega\vartheta < 1$; in relation to a magnetohydrodynamic wave, viscous plasma

is a dispersing medium; at $V_0^2/\omega\vartheta > 1$ the attenuation is $S = (\omega^2\vartheta/2V_0^3)\,[1 - (c^2\nu\omega^2/2\pi\sigma V_0^4)]$; the attenuation of magnetohydrodynamic waves in plasma cannot be of unlimited low value and the concept of undamped waves cannot be regarded as correct when applied to solar conditions; magnetohydrodynamic waves cause the appearance of strongly damped longitudinal waves which, under certain conditions, dissipate considerable energy; and in high-conductivity plasma, the depth of penetration of viscous waves may exceed considerably the depth of penetration of electromagnetic waves, although the former carry only an insignificant amount of the energy. (OTS)

9532 HYDRODYNAMIC AND HYDROMAGNETIC SHOCK WAVES IN CONTROLLED THERMONUCLEAR FUSION. M. McChesney. Engineer, 212: 1071-4(Dec. 29, 1961).

The physical principles are described of a shock wave which arises when a thermonuclear pinched discharge is created. Distinction is made between two kinds of shock waves, namely, the hydrodynamic case where no magnetic field is involved and the hydromagnetic case when the shock wave propagates into a gas containing a magnetic field. The limitations of the former for heating the gas are discussed and the unusual features and problems of the latter are indicated. (auth)

9533 MOTION OF PLASMA THROUGH A PIPE PLACED IN EXTERIOR CROSSED ELECTRIC AND MAGNETIC FIELDS. V. M. Sarychev. Intern. Chem. Eng., 2: No. 1, 90-4(Jan. 1962). (In English)

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 28257.

9534 EXTINCTION OF ARC DISCHARGE BY A TRANSVERSE MAGNETIC FIELD. A. A. Potsar and V. N. Chernigovskii. Izvest. Leningrad. Elektrotekh. Inst., 39: 105-11(1959).

Processes taking place in an arc discharge are theoretically considered in a simple manner; it is shown that application of a transverse magnetic field to discharge can lead to its extinction. Moreover, pressure and current increases, which generate an excessive negative charge on the walls, must increase the critical magnitude of the magnetic field which extinguishes discharges. Experiments were carried out which corroborated the correctness of the conclusions drawn. It is suggested that the possibility of arc discharge extinction by magnetic fields may be used for designing powerful gas discharge devices with short-time deionization. (Referat. Zhur. Fiz, No. 4, 1961.)

9535 SPECTROSCOPIC MEASUREMENTS OF TEMPERATURES AND DENSITIES IN A CESIUM PLASMA. Robert J. Donohue and Richard F. Majkowski (General Motors Research Labs., Warren, Mich.). J. Appl. Phys., 33: 3-10(Jan. 1962).

The ion, electron and atom number densities, and electron temperatures of a cesium plasma generated in a diode were measured by spectroscopic techniques. Theoretical bases are outlined. Errors involved in applying these theories to heavy atom collision-dominated plasmas are discussed. Working equations for the electron, ion and atom temperatures, and number densities are developed. Among the working equations developed and applied are those for the determination of the electron number density from the continuum intensity and Stark broadening. Temperatures in the cesium plasma were 0.7 ev with ion and electron number densities of the order of 10^{15}cm^{-3}. The agreement of cesium pressure computed from the spectroscopically determined temperatures and number densities and that from vapor pressure curves strongly suggest the existence of thermal equilibrium. The agreement in the values of electron number densities determined from continuum intensity and Stark broadening measurements justify the approximations made in applying these theories to the cesium plasma. (auth)

9536 IMPEDANCE CHARACTERISTICS OF A MERCURY-VAPOR PLASMA. F. W. Crawford (Stanford Unif., Calif.). J. Appl. Phys., 33: 20-5(Jan. 1962).

Measurements of the impedance/frequency characteristics of a hot-cathode, d-c, mercury-vapor plasma were made at a pressure of approximately 1 μ. The experimental tube contained a directly-heated cathode from a commercial mercury-vapor rectifier and provided a discharge column 80 cm long. Bridge techniques were used to obtain impedance loci extending to 2 Mc/sec for several values of anode current. These appeared to normalize, the magnitudes of the components being approximately inversely proportional to current. A basic equivalent circuit can be deduced, its parameters being dependent on physical processes occurring in the discharge. Prominent frequency components of the low-frequency voltage fluctuations present in the tube appear to be closely related to the impedance characteristics. (auth)

9537 PULSED PROBE MEASUREMENTS. D. G. Bills, R. B. Holt, and B. T. McClure (Harvard Univ., Cambridge, Mass.). J. Appl. Phys., 33: 29-33(Jan. 1962).

A pulsed probe was used to measure certain parameters of a time-varying plasma in mercury vapor. Langmuir probe characteristics were obtained by pulsing the probe voltage to successively higher values for μsec intervals at specific times relative to a repetitive discharge pulse. Curves showing the time dependence of the plasma potential, electron temperature, and electron density relative to this pulse are presented. The probe characteristics do not exhibit a sharp break at the plasma potential. This is related to a disturbance of the plasma by the probe. A novel and precise technique for determining the actual plasma potential is described. This technique depends upon the abrupt appearance of a spike on the leading edge of the probe current pulse. (auth)

9538 MAGNETIC EFFECTS IN A PLASMA COLUMN IRRADIATED WITH MICROWAVES. W. D. Hershberger and Irene Petroff (Univ. of California, Los Angeles). J. Appl. Phys., 33: 227-8(Jan. 1962).

A coherent circular orbital motion is imparted to the electrons in the plasma at its principal resonance frequency. The column is irradiated with two incoming waves of the same frequency (but differing in phase at the column by 90°) arranged so that the directions of propagations of the first and second waves and the column axis are mutually perpendicular. The electric fields of both waves are also perpendicular to this axis. The resulting magnetic moment is directed along the axis of the column, and changes in the bulk magnetization are detected using a pickup coil. The plasma column is irradiated using a pulsed 10-kw magnetron operating at 9400 mc. Measured voltage across the coil agrees reasonably well with calculated values. Electron orbits are calculated. (L.N.N.)

9539 BACKWARD WAVES ON ISOTROPIC PLASMA SLABS. A. A. Oliner and T. Tamir (Polytechnic Inst., Brooklyn). J. Appl. Phys., 33: 231-3(Jan. 1962).

It is shown that backward waves are possible even though periodicity, anisotropy, inhomogeneity, or hybrid modes are not present. A lossless, homogeneous, and isotropic plasma slab may support backward surface

waves, that exist because the plasma relative dielectric constant ϵ_p may become negative. These waves may exist for any $\epsilon_p < 0$. (L.N.N.)

9540 PROGRESS IN RESEARCH TODAY: STATUS OF WORLD FUSION. R. J. Bickerton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucleonics, 20: No. 2, 55-9(Feb. 1962).

Optimistic about reaching their ultimate goal of controlled fusion, experts in fusion around the world report that recent research has solved some mysteries of plasma instabilities. In particular, the devices that show the most promise at the moment for ultimate fusion power include the magnetic-mirror and cusp-geometry machines. Some of the properties and parameters of the following types of machines are given: toroidal pinch, theta pinch, compressional mirror, stellarator, injection mirror, and cusped-field machines. Research in basic plasma physics indicates that much of the experimental work agrees satisfactorily with theory. (N.W.R.)

9541 MAGNETO-COMPRESSIONAL DISTURBANCE IN A TEPID PLASMA. P. L. Auer and J. A. Nation (EURATOM—C.N.E.N., Rome). Nuovo cimento (10), 22: 533-47(Nov. 1, 1961). (In English)

An essential feature of the non-linear pulse theory for plasma is that the fields rise exponentially in the region of the undisturbed plasma, a result which may be obtained also from the linearized theory. The propagation of steady state pulses traveling perpendicular to a magnetic field in a cold plasma is studied in the steady state in order to establish whether the plasma is capable of supporting exponentially rising fields. A linear and a quasi non-linear analysis of the problem is given and it is shown that pulses exist when the disturbance speed is supersonic. It is also shown that the range of disturbance velocities, for which pulses are formed, is reduced in a highly non-analytic manner by a spread in the initial velocities. (auth)

9542 THE ROLE OF ION CURRENTS IN THE FORMATION OF SPACE CHARGE SHEATHS IN A LOW PRESSURE ARC. P. L. Auer (EURATOM—C.N.E.N., Rome). Nuovo cimento (10), 22: 548-64(Nov. 1, 1961). (In English)

It is shown that conditions leading to the establishment of a space charge sheath in the positive column of low pressure arcs provide for a minimal requirement in the positive ion current delivered to the sheath. The minimum required current for a given ion is a function of only the electron density and temperature and is independent of the specific mechanism of ion production for the special case of a plane symmetric discharge. These conclusions are used to analyze the Bohm criterion. The effect of magnetic fields and possible plasma instabilities is briefly examined. (auth)

9543 HARMONICS OF THE KRUSKAL LIMIT AND FIELD DIFFUSION IN A TOROIDAL PINCH DISCHARGE. A. A. Ware, H. K. Forsen, and A. A. Schupp (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Rev., 125: 417-27(Jan. 15, 1962).

Measurement of the magnetic fields in a toroidal pinch discharge show that when the applied toroidal magnetic field (B_{z0}) is comparable with or less than the self-field of the discharge (B_θ), the B_θ field penetrates into the discharge more rapidly than expected by simple electromagnetic theory, and the B_z flux is enhanced within the discharge. This second effect was very marked because of the high impedance of the supply circuit connected to the B_z coils. The magnetic field oscillograms show steps beginning when the magnetic pitch ($\lambda_B \simeq 2\pi r B_z/B_\theta$) satisfied $\lambda_B \simeq L/n$ or $2L/n$, where L is the torus circumference and n is an integer. If it is assumed that instabilities prevent the formation of a large pressure gradient in the discharge, then $j_\perp \ll j_{||}$, and the field configurations predicted for an applied electric field (E_z) are in agreement with those observed experimentally after field penetration is complete. In particular, the enhancement of B_z is explained. Further, the assumption of small $j_{||}$ leads to the prediction of more rapid B_θ penetration at low B_z. The most likely instabilities which would cause the limitation in pressure gradient and produce the waveform steps are thought to be interchange modes. (auth)

9544 ON THE VALIDITY OF THE ADIABATIC APPROXIMATION IN THE THEORY OF ELECTRON BROADENING IN A PLASMA. Shigeru Matsuo (Kyoto Univ.) and Hajime Narumi. Progr. Theoret. Phys. (Kyoto), 26: 424-6(Sept. 1961). (In English)

Validity of the adiabatic approximation is verified for some values of effective potential in electron impact broadening. Using the Lyman-α line, it is shown that this approximation is not always valid, however. (L.N.N.)

9545 A PLASMA ACCELERATOR AND MODIFIED PICKET-FENCE MAGNETIC FIELD PLASMA CONTAINMENT DEVICE. (to U. S. Atomic Energy Commission). British Patent 888,108. Jan. 24, 1962.

A novel plasma containment device is designed in which a plasma jet is injected into a magnetic field at a very high energy and trapped therein. The device comprises means for accelerating a deuterium plasma to a velocity of $\sim 10^7$ cm/sec and coil means for producing a modified picket-fence magnetic field having two point cusps and one ring cusp. (D.L.C.)

9546 FUELING OF THERMONUCLEAR REACTORS. (to U. S. Atomic Energy Commission). British Patent 888,720. Feb. 7, 1962.

Methods are described for fueling thermonuclear reactors of the type disclosed in British Patent 880,124 with cold neutral particles after a hot plasma has been established. The problem is for the neutral particles to penetrate the plasma sufficiently before being ionized. For reactors having two magnetic mirror regions separated by a uniform magnetic field, cold neutral particles can be injected through a mirror region at an angle greater than the critical angle for containment. For reactors having toroidal chambers, the particles must have an energy of ≥1 kev and be injected transverse to the reactor axis. (D.L.C.)

9547 IMPROVEMENTS IN OR RELATING TO ENERGY TRANSFER CIRCUITS. Robert Carruthers and David Lorimer Smart (to United Kingdom Atomic Energy Authority). British Patent 888,888. Feb. 7, 1962.

An energy transfer circuit is designed for efficient energy transfer from an inductive store to an inductive load, such as a gas discharge apparatus comprising a transformer whose secondary winding is the pinched ring discharge. The circuit comprises a storage inductor, means for charging the store, and an inductive load and a capacitor connectable in parallel with the store. After the store is charged and the load and capacitor are connected to it, a resonant circuit is thereby formed which oscillates for at least one half cycle at the resonant frequency and the current in the load increases to a maximum value. (D.L.C.)

9548 PLASMA HEATING AND CONFINING DEVICE. William R. Baker, Al Bratenahl, and W. B. Kunkel (to U. S. Atomic Energy Commission). U. S. Patent 3,021,272. Feb. 13, 1962.

A device is designed for generating, heating, and containing a very pure electrical plasma. Plasma purity is maintained by preventing the hot plasma from contacting insulators, which are a principal source of impurities in prior constructions. An insulator is disposed at each end of a pair of long coaxial cylinders forming an annular chamber therebetween. High voltage is applied between the cylinders and an axial magnetic field is created therethrough. At a middle position on the inner cylinder, a fast-opening valve releases a quantity of gas into the chamber, and before the gas can diffuse to the distant insulators, a discharge occurs between the cylinders and plasma is formed in the central region of the chamber away from the insulators. (AEC)

9549 RADIO-FREQUENCY PLASMA CONTAINING DEVICE. Aaron J. Ulrich, James W. Butler, and Albert J. Hatch (to U. S. Atomic Energy Commission). U. S. Patent 3,022,236. Feb. 20, 1962.

A method and means are described for confining and compressing a dense plasma. The device comprises an evacuated spherical cavity into which is injected a heavy hydrogen isotope gas. Thyratron tubes are operated in time quadrature to excite rotating radio-frequency fields within the cavity in the even and odd TE_{111} modes. The excited radio-frequency fields ionize the gas and compress it toward the center of the cavity. (AEC)

Shielding

9550 (DC-51-11-26) HYDROGENOUS SHIELD MATERIALS. SURVEY OF RADIATION DAMAGE. An Evaluation Report. F. H. Welch and L. J. D'Antonio (General Electric Co. Aircraft Nuclear Propulsion Project, Cincinnati). Nov. 23, 1951. Contract [AT(11-1)-171]. 32p.

Available information is summarized on radiation damage to hydrogenous materials of interest as possible shield materials. Of those tested, polyethylene appears to have the most acceptable properties with respect to density, H content per unit volume, and radiation stability. Alkylbenzene appears to have properties comparable to polyethylene. Other materials are discussed, and recommendations for future studies are included. (43 references). (C.H.)

9551 (NAA-SR-Memo-1891) SHIELDING OF THE SPPP CRITICAL FACILITY. R. L. Tomlinson (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 9, 1957. Contract [AT(11-1)-Gen-8]. 26p.

Neutron distribution and leakage were calculated for SPPP critical assemblies and the possible modifications of a building for the shielding of the assemblies were studied. (D.L.C.)

9552 (TID-3303(Suppl.1)) RADIATION SHIELDS AND SHIELDING. Henry D. Raleigh, comp. (Division of Technical Information Extension, AEC). Apr. 1961. 108p.

Selected references to unclassified reports and journal literature on radiation shields and shielding are given. The period July 1956 to January 1961 is covered. The 687 references include information on gamma and neutron attenuation, shield design, engineering and nuclear properties of materials, economic aspects of shielding, shield heating, and shielding theory. (M.C.G.)

9553 (AEC-tr-4881) A NEW PRESTRESSED CONCRETE SHIELD FOR PRESSURIZED ATOMIC REACTORS. Translated from French Patent No. 775,380. Sept. 26, 1958. 9p.

A shield of prestressed concrete was developed for a pressurized reactor keeping the reactor under pressure and providing biological protection. This shield has the approximate shape of a revolution cylinder closed at each of its extremeties by a hemisphere with its concavity turned toward the outside. It is constructed of prestressed concrete applying the prestressing force along the generators of the cylinder on one hand and along the section of the cylinder on the other hand. It is basically characterized by the fact that the prestressing according to the sections of the cylinder is accomplished by a system of straight-line cables. (auth)

9554 (AEC-tr-4882) A NEW SHIELD FOR PRESSURIZED ATOMIC REACTORS. Translated from French Patent No. 752,436. Nov. 26, 1957. 12p.

A shield was developed for a pressurized atomic reactor which makes it possible to reduce considerably the volume of the leaktight vessel. This shield is fundamentally characterized by the fact that the functions of biological protection and resistance to pressure are provided simultaneously by a single system made of concrete and subjected to centripetal stresses superior to the tensions caused by the internal pressure of the cooling fluid, applying these stresses by means of several bundles of metallic cables distributed around or within the shield, applying the tension during the assembly, the eventual friction of these cables on the concrete may be reduced by interposing suitable sliding mechanisms. (auth)

9555 INVESTIGATION OF THE NUCLEAR CASCADE IN SHIELDING MATERIALS. A. Citron (CERN, Geneva), L. Hoffmann, and C. Passow. Nuclear Instr. & Methods, 14: 97-100(Nov. 1961). (In English)

The build-up of the nuclear cascade and its subsequent attenuation were measured in two types of concrete and earth, using protons from the CERN-PS as primary radiation. From a narrow and a wide beam experiment the following lower limits for characteristics of the cascade are found: there is a region of a full width of 550 g cm^{-2} in which the intensity increases by a factor of 3, and drops down again to the initial value; this is followed by a nearly exponential decrease of the intensity of the radiation with an attenuation length of 145 ± 10 g cm^{-2}. (auth)

9556 GAMMA ATTENUATION NOMOGRAM FOR CONCRETE. S. E. Pihlajavaara and Esko Pihlman. Valtion Tek. Tutkimuslairos, Tiedoitus, Sarja III, 1-28 (1961). (In Finnish and English)

The gamma attenuation nomogram for concrete walls is presented and is based on a radiation dose rate of 1 mrem/h. The nomogram is mainly for determination of the thickness of the shield when the source of radiation is known and the allowable dose rate is fixed. Four examples are given which elucidate the application of the nomogram. The problems are solved by trial and error until a desirable solution is found. The basic equation for this trial and error method is presented and explained. (N.W.R.)

Theoretical Physics

9557 (LAMS-2616) COULOMB WAVE FUNCTIONS. John G. Belinfante (Los Alamos Scientific Lab., N. Mex.). Sept. 14, 1961. Contract W-7405-eng-36. 41p.

Nonrelativistic Coulomb scattering wave functions are reviewed. Those properties which are most useful to a physicist who wishes to apply the results to scattering problems are emphasized, and simple derivations of the most important properties are supplied. No attempt was made at completeness. A notation was adopted which

emphasizes the analogy with the simpler formulas that result when the charge vanishes. In addition to the scattering problem, the bound state problem is also discussed; only for the nonrelativistic case are all details of the wave function including the normalization given. For the relativistic treatments, which include both Klein-Gordon and Dirac equations, the spectrum of energy levels was derived. (auth)

9558 (NP-11225) FINAL REPORT [ON STATISTICAL MECHANICS]. J. L. Lebowitz (Yeshiva Univ., New York. Graduate School of Science). Nov. 1961. Contract AF49(638)-753. 12p.

A survey is presented of statistical mechanics investigations of problems dealing with systems in equilibrium and with equilibrium processes, the derivation of the H-theorem for plasmas, the dissociation rate of a diatomic molecule in an inert gas, and the motion of Brownian particles in fluids. (B.O.G.)

9559 (NP-11327) ON THE VALIDITY OF THE CROSSING THEOREM. L. O'Raifeartaigh (Dublin Inst. for Advanced Studies). Nov. 1961. 19p.

The validity of the crossing theorem in quantum field theory was investigated for the case of a complex scalar field in interaction with any other spinor or tensor fields by means of a certain class of interaction Hamiltonians. It was found that the validity of the crossing theorem can be guaranteed, if, and only if, the interaction Hamiltonian is causal and conserves the charge. Some implications of this result are discussed. (auth)

9560 (UCRL-9875(Vol.I)) LECTURES ON THE S-MATRIX THEORY. Lectures I thru VIII Covering Period: September 25, 1961–November 3, 1961. Henry P. Stapp (California. Univ., Berkeley. Lawrence Radiation Lab.). Contract W-7405-eng-48. 108p.

The lectures on the S-matrix theory are given as an elaboration of a paper on the derivation of the CPT Theorem and the connection between spin and statistics from postulates (report number UCRL-9804). Following an introductory explanation of the role of postulates in physical interpretations, the lectures are given in terms of analyticity postulates, relativistic invariance, unitarity, related formalisms, order of variables and antiparticles, the CPT theorem, and the connection between spin and statistics. (B.O.G.)

9561 DETERMINATION OF A POTENTIAL FROM ITS ENERGY LEVELS AND UNDETECTABILITY OF QUANTIZATION AT HIGH ENERGY. Joseph B. Keller (New York Univ., New York). Am. J. Phys., 30: 22-6(Jan. 1962).

The problem of determining a spherically symmetric potential from its energy eigenvalues E_n in states of zero angular momentum is solved approximately. The corresponding problem for a one-dimensional potential is also solved. It is incidentally shown that the large eigenvalues depend only upon the width of the potential as a function of height rather than on its precise shape. The level spacing $E_{n+1} - E_n$ is investigated for a one-dimensional potential. It is shown that the spacing does not increase faster than $\sqrt{E_n}$ for large values of E_n. Thus the relative spacing $(E_{n+1} - E_n)/E_n$ decreases faster than $1/\sqrt{E_n}$ for large E_n. This fact is proposed as an explanation for the undetectability of quantization at high energies. It is also shown that of all potentials having a given width at the energy E and a given depth, the square well has the greatest spacing at E. The corresponding classical mechanical problems, which concern nonlinear vibrations, are also considered. (auth)

9562 RELATIVISTIC QUANTUM THEORY AS A GROUP PROBLEM. I. GENERAL FORMALISM. Y. Ahmavaara. Ann. Acad. Sci. Fennicae, Ser. A, VI, No. 85, 1-43(1961). (In English)

Recent considerations of the renormalized quantum field theory from the point of view of the 'general principles' show that the essentials of the relativistic quantum theory can probably be given the form of a pure invariance and transformation scheme. The general group formalism that replaces, in this kind of quantum theory, the Hamiltonian formalism of the conventional quantum theory is investigated. The notions of world and geometry are given abstract formulations in terms of topological spaces and groups. The local world geometry is given by a local group of transformations defined locally in the world. It is shown that an essential part of this local group can always be extended to a full group of transformations in a real vector space, associated with the world as an 'adjoint space.' The universal covering group of the extensions of the local world geometry to full groups defines the basic group of the quantum theory. The observable quantities are defined in terms of the enveloping algebra of the basic group. The algebraic reductions of this algebra, determined by its ideals, lead to the notion of particle. Also the Hilbert space of the states, as well as the representation of the enveloping algebra (including the representation of the basic group and the observable quantities) in the Hilbert space, is constructed by an algebraic reduction. The creation and the annihilation operators are introduced as a complete covariant system in the Hilbert space, and a partial contraction is defined for them. The scattering operator is defined in terms of the invariants, obtainable by this contraction. (auth)

9563 UNIQUENESS OF THE ELECTRON POLARIZATION OPERATOR. M. E. Rose (Univ. of Virginia, Charlottesville) and R. H. Good, Jr. Nuovo cimento (10), 22: 565-8(Nov. 1, 1961). (In English)

The most general three-vector polarization operator, which commutes with the Hamiltonian and has the algebra of spin one-half, is constructed for a free Dirac particle. The non-uniqueness inherent in this operator may be resolved by imposing either of two conditions: that the operator should be well-defined in the rest system; or that it should correspond to the space part of a four-vector operator evaluated in the rest system. In either case the operator obtained is the Foldy-Wouthuysen transform of the matrix $\beta\sigma$. (auth)

9564 TENSOR OPERATOR FOR ELECTRON POLARIZATION. D. M. Fradkin (Ames Lab., Ames, Iowa) and R. H. Good, Jr. Nuovo cimento (10), 22: 643-9(Nov. 1, 1961). (IS-369). (In English)

It is shown that the polarization of a free Dirac particle can be treated in a covariant way in terms of an antisymmetric second-rank tensor operator that commutes with the Hamiltonian. The operator has the interpretation that in the rest system of the particle the space-space part is the spin and the space-time part is zero. In the quantized theory the second-rank tensor description of the polarization is a more appropriate notion than the four-vector description. The converse holds for the Foldy-Wouthuysen mean spin. (auth)

9565 TRANSITION PROBABILITY DUE TO RANDOM PERTURBATIONS. Amnon Yariv and W. H. Louisell (Bell Telephone Labs., Murray Hill, N. Y.). Phys. Rev., 125: 558-60(Jan. 15, 1962).

The subject of transition probabilities induced by random

perturbations is treated. The expression for average transition rates between two energy levels is derived for the general case in which the frequency spectrum of the perturbation and the distribution of the energy levels have comparable widths. The general expression takes an especially simple form for cases in which the frequency bandwidth of the perturbation Hamiltonian is either much larger or much smaller than that of the energy level distribution. The formulas are applied to physical problems. (auth)

9566 WAVE FUNCTIONS. R. E. Cutkosky (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev., 125: 745-54 (Jan. 15, 1962).

A convenient definition of wave functions, in terms of S-matrix quantities, may be obtained from the dispersion relations for hypothetical reactions in which a probe interacts impulsively with a target. The wave functions defined in this way are useful for constructing an impulse approximation for complicated reactions. These wave functions also satisfy a wave equation. (auth)

9567 THE SINGULARITY OF PROPAGATORS IN FIELD THEORY AND THE STRUCTURE OF SPACE-TIME. Yoshiro Takano (Yokohama National Univ., Japan). Progr. Theoret. Phys. (Kyoto), 26: 304-14(Sept. 1961). (In English)

The singularity of propagators in field theory can be removed by introducing the distribution, or the fluctuation, of space-time. The fluctuation of space-time is assumed to result from the existence of elementary particles. (auth)

9568 NUCLEAR MATTER AT LOW DENSITY WITH ATTRACTIVE AND SINGULAR INTERACTIONS. Yasushi Wada (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 26: 321-36(Sept. 1961). (In English)

The theory of nuclear superfluidity is presented making use of the independent-pair-approximation developed in the Brueckner theory. The relation between the theories is clarified. A stable configuration of the system is determined by the correlation function between the pairs which satisfies the Cooper-Mills-Sessler (CMS) equation. This equation is simplified such that the correct energy gap can be obtained after the simplification. The variational principle used by CMS gives a lower bound to the energy gap. The simplified equation is solved in the low-density limit without making any particular assumption about the two-body potential. When the attraction is so weak as to give a negative scattering length, a diffused Fermi distribution becomes stable. The exact energy gap in this limit is shown to be smaller by the factor $\exp(-2)$ than that of Emery and Sessler. (Phys. Rev. 119, 248(1960)). If the attraction is strong enough to create a bound state the Fermi distribution is completely diffused. The energy gap is twice the binding energy. Finally, the insufficiency of the independent-pair-approximation is indicated. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

Refer also to abstract 8784 and 8864

9569 (AAEC/E-82) FUEL ELEMENT TRANSIENT TEMPERATURE STUDIES. J. J. Thompson (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Nov. 1961. 11p.

A method is presented for the analysis of transient temperatures in a homogeneous circular cylindrical fuel element in a coolant channel with no axial conduction and no heat loss to the channel wall. In addition, some results were obtained for mean fuel element temperatures in power transients for a simpler model, but accounting for details of the axial coolant temperature distribution in the unsteady state. (auth)

9570 (AEEW-R-112) THE SPATIAL AVERAGING OF REACTOR VARIABLES IN TRANSIENT CALCULATIONS. R. Potter and J. Graham (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Dec. 1961. 26p.

In many cases of practical importance it is possible in transient calculations to consider only axial variations of flux distribution and to use a one-dimensional model of the reactor. In other cases it is adequate to take averages over the whole reactor. However in all these cases it is necessary to have a well founded method of obtaining the averages of reactor variables. Some effects which are strictly three-dimensional, but which can be calculated separately, such as leakage changes arising from flux variations due to control absorber movement, can be included. The appropriate form of the one-group diffusion equation and delayed neutron equations for a one-dimensional axial analysis and for a whole reactor mean model are presented. Expressions are derived for the modifications to the standard equations introduced by the movement of control absorbers. Numerical values of these expressions for the case of a Calder Hall type power reactor are given. Only the one-group diffusion equation is considered, since the method was developed for large, low enrichment power reactors in which this is a satisfactory approximation for transient calculations. Extension to multigroup calculations would be possible. (auth)

9571 (CNEN-82) STUDIO SULL'EFFICIENZA DELLE BARRE DI CONTROLLO IN UN REATTORE CILINDRICO. (Study on the Effectiveness of the Control Rod in a Cylindrical Reactor). P. Azzoni and F. Casali (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Nov. 1961. 24p.

The conditions for criticality and resulting flux distribution were obtained in one group diffusion theory approximation for a ring of three equally spaced identical rods embedded symmetrically in a radial reflector of a two region, cylindrical reactor. The method used was a generalization of the Nordheim-Scalettar method. (auth)

9572 (CRRP-1064) MEASUREMENTS MADE IN THE POOL TEST REACTOR DURING THE PERIOD FROM NOVEMBER 1957 TO JUNE 1958. D. S. Craig and G. L. Keech (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nov. 1961. 57p. (AECL-1407)

A comparison was made of the measured and calculated critical masses for a water-reflected core, a graphite-reflected core, and a graphite-reflected core with an internal water thermal column. Measured values are given of the worth of the absorber rods in the first of these assemblies, and of one rod over a limited range in the second assembly. Values are also given for the void coefficients and $r\sqrt{T/T_0}$ for several positions in these assemblies. A determination of the effective delayed neutron fraction is discussed. (auth)

9573 (DC-58-8-223) REACTOR STARTUP CONTROL COMPONENT DEVELOPMENT. Robert H. Willsey, Paul K. Hiser, Merle E. Ward, and Archie D. Wilcox (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 27, 1958. Contract AT(11-1)-171. 76p.

Some of the reactor startup control electrical components currently being developed in the ANP Department are described. The system function, electrical performance requirements, sensitivity to temperature, and the size and shape characteristics are described. Planned environmental tests and development goals are listed. Component life in nuclear radiation fields is estimated. Block diagrams, electrical schematics, response plots, photographs and drawings are used to give an up-to-date picture of the status of these developments. The automatic checkout feature of the system is presented and described. (auth)

9574 (DC-59-7-2) REACTOR CONTROL COMPONENTS STUDY. PART II. A PULSE RELAXATION AMPLIFIER CIRCUIT ANALYSIS. D. L. Watrous (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Jan. 27, 1959. For General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati. Contract AT(11-1)-171. 36p.

An analysis was made of a basic pulse relaxation amplifier, (PRA), circuit. Then, several reactor pulse tests were conducted to gain practical design information. A typical PRA amplifier was built and evaluated. Finally, a set of design requirements was formulated. (auth)

9575 (HW-68284) THE VARIATIONAL METHOD AND REACTOR PHYSICS. C. W. Lindenmeier (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 26, 1961. Contract [AT(45-1)-1350]. 18p.

Some of the less familiar mathematical methods required in developing a variational formulism for reactors are described and applied to obtain the multi-group approximation. Linear spaces, adjoint spaces, linear operator, adjoint operators, Green's function, physical interpretation of the adjoint, variational methods, variational functional in the diffusion, trial functions, the multi-group approximation, and overlapping and non-overlapping trial spectra are discussed. (M.C.G.)

9576 (JPL-TR-32-189) THERMAL AND CRITICALITY ANALYSIS OF THE PLASMA CORE REACTOR. D. F. Spencer (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Jan. 1, 1962. Contract NASw-6. 50p.

Radiative heat transfer to the propellant and reactor criticality for a fissionable gaseous rocket engine are analyzed to determine their interdependence. The necessity for propellant thicknesses of approximately 1 to 3 m due to poor thermal absorption properties of hydrogen significantly affects reactor critical radius and mass. The two primary adverse effects are: (1) increased absorption in the reflector-moderator for a given reflector thickness and (2) poor utilization of thermal neutrons by the core due

to the lower geometrical view factor of the core for the reflector walls. In fact, there is a minimum core radius at a particular propellant thickness which allows the system to "go" critical. Engine performance is limited primarily to two regions of operation: the first, a specific impulse of approximately 1550 sec at a thrust level of 2×10^6 lb and second, a specific impulse of approximately 2200 sec at a thrust level of 5.3×10^6 lb. (auth)

9577 (LAMS-2650) QUARTERLY STATUS REPORT ON ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX) FOR PERIOD ENDING NOVEMBER 20, 1961. (Los Alamos Scientific Lab., N. Mex.). Dec. 1961. Contract W-7405-Eng-36. 18p.

The detailed design of the reactor proper was essentially completed and preparations were made for procurement of the carbon components and the pressure vessel. Design of the UHTREX facility has progressed to Title II. Design information is included on copper oxide beds and molecular sieves for gas cleanup. In other work, irradiation of capsules containing UHTREX fuel elements is reported along with fuel recycle research. (J.R.D.)

9578 (NDA-2131-43) PAWLING LATTICE TEST RIG—TEST REPORT NO. 2, 37-ROD CLUSTER—11.1 IN. LATTICE PITCH. W. L. Brooks, G. G. Foster, and R. D. Schamberger (United Nuclear Corp. Development Div., White Plains, N. Y.). Dec. 31, 1961. Contract AT(30-1)-2836. 46p.

The Pawling Lattice Test Rig was used to determine the reactivity of the "base case" lattice and the effect on reactivity of several variations such as coolant void and fuel cluster geometry. The results of the measurements of $K\infty$ for the various cases are presented in tabular form. The complete removal of the coolant from the basic cluster configuration increased $K\infty$ by 0.0261 ± 0.0025. The partial coolant removal experiments suggested that the void coefficient inside the cluster is more positive than in the area immediately around the outside of the cluster and that the void coefficient decreases with increasing rod-rod pitch. The experiments to determine the void coefficient at the insulating gap showed an increase in $K\infty$ when the gap was filled with D_2O. The value of $K\infty$ was reduced when the fuel rod-rod pitch was increased. (M.C.G.)

9579 (ORNL-TM-114) VOID COEFFICIENT OF REACTIVITY ASSOCIATED WITH THE ISLAND REGION OF THE HFIR. R. D. Cheverton (Oak Ridge National Lab., Tenn.). Nov. 15, 1961. Contract [W-7405-eng-26]. 7p.

Changes in neutron multiplication caused by voids in the island of the HFIR were calculated and measured experimentally. The results indicated that with only water initially in the island the maximum change in neutron multiplication (Δk_{max}) associated with island voids is 0.032 with a corresponding void fraction of 70%. With a simulated 300 g Pu target in the island Δk_{max} was 0.016, and the corresponding void fraction was 42%. In view of these large changes in neutron multiplication, calculations were made to determine what additional materials could be used in the island to reduce Δk_{max} and what the associated decrease in peak thermal flux would be. The results indicated that of the materials considered the use of beryllium in the water island resulted in the smallest decrease in flux for a specified Δk_{max}. To reduce Δk_{max} to 0.01 required 26% by volume of beryllium in the island; the corresponding reduction in thermal flux, as compared to an all-water island, was about 10%. In order to reduce Δk_{max} to 0.01 with a 300 g Pu target in the island, the aluminum-to-water ratio of the target had to be increased from 0.54 to about 1.5 with an associated decrease in target-averaged thermal flux, as compared to the original target, of 17%. (auth)

9580 (ORO-522) PRELIMINARY PROPOSAL FOR FAST BURST REACTOR FACILITY, BUILDINGS 7709, 7710 AND 7711, ORNL AREA, OAK RIDGE, TENNESSEE. (Giffels and Vallet, Inc., Detroit). [1960]. Contract AT-(40-1)-2511. 115p.

The extent and proportions, type of construction, and approximate cost of the buildings and equipment required to operate the ORNL Fast Burst Reactor facility and its associated experiments are outlined. The major engineering and construction work concerns the reactor containment building, the reactor control building, special equipment, and the site. (T.F.H.)

9581 (PWAC-112) STATUS OF THE MECHANICAL DESIGN OF THE SCWR. (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Feb. 23, 1955. Contract [AT (11-1)-229]. 48p.

The conceptual and analytical phases of the design of the Supercritical Water Reactor, now largely completed, are given and the status of incomplete work summarized. (D.L.C.)

9582 (TID-14824) A TRANSISTORIZED REACTIVITY COMPUTER. R. F. Shea (Knolls Atomic Power Lab., Schenectady, N. Y.). [Oct. 1, 1961]. Contract [W-31-109-Eng-52]. 20p.

Reactor kinetics equations are shown to consist of three major components: a fast term, a product or quotient, and a summation of transient terms. These can be synthesized by using a number of simple R-C networks having time constants related to the fast time constant and to the decay constants of the various groups of delayed neutron emitters, plus either an analog multiplier or divider. If an input signal proportional to neutron flux or reactor power is applied to this network, the output is proportional to reactivity. A circuit is shown that incorporates these principles, using a diode divider. Curves are presented of output reading, indicating transient reactivity, for input currents having constant positive period, as obtained from a motor-driven potentiometer. It is shown that these curves are in agreement with calculated curves of reactivity for such periods. (auth)

9583 (UCRL-5956) SOPHIST I—AN IBM 709/7090 CODE WHICH CALCULATES MULTIGROUP TRANSFER COEFFICIENTS FOR GASEOUS MODERATORS. Eugene H. Canfield, Richard N. Stuart, Robert P. Freis, and William H. Collins (California. Univ., Livermore. Lawrence Radiation Lab.). Oct. 19, 1961. Contract W-7405-eng-48. 25p.

SOPHIST I, a Fortran IBM 709/7090 code compatible with MONITOR, calculates temperature-dependent scattering transfer coefficients for use in multigroup diffusion codes. The moderator model is a Maxwell gas with elastic, isotropic scattering in the center of mass. SOPHIST I supersedes older versions with its greater speed, accuracy, and flexibility. The equations have been analytically reduced to one-dimensional integrals whose accurate evaluation is assured. Options allow analytic or arbitrary pointwise flux spectrums and a variable moderator mass for approximating chemical binding or crystalline effects. (auth)

9584 (CEA-tr-R-1420) POSSIBILITE D'IMITER LES SYSTEMES DE PUISSANCE NUCLEAIRE. (Possiblities of Simulation of Nuclear Power Systems). B. Ya. Kogan, Yu. A. Nechaev, and F. E. Tranin. Translated into French from Avtomat. i Telemekh., 20: 349-54(1959). 17p.

The possibility is considered of using analog computer methods in solving nuclear energy problems. Examples are given of the results obtained by these methods in problems involving reactor kinetics and reactor poisoning. (tr-auth)

9585 (FTD-TT-61-170) NUCLEAR ENERGY (SELECTED ARTICLES). Translated from Atomkernergie, 6: 273-85; 309-17(1961). 69p.

Two papers are included which treat the long-term behavior of a heavy-water reactor with outer control rods and the leakage rates of reactor pressure vessels, respectively. Both papers were previously abstracted in NSA. (D.L.C.)

9586 STORED ENERGY IN THE OAK RIDGE GRAPHITE REACTOR–1960. M. C. Wittels (Oak Ridge National Lab., Tenn.). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 15: 185-91(Dec. 1961).

The stored-energy status of the Oak Ridge Graphite Reactor, which went into operation in November, 1943, was analyzed following a low temperature anneal in which fission heat and a reverse air flow system were employed. From more than 100 post-annealing core samples, calorimetric studies revealed that the success of the annealing operation closely conforms to the maximum temperature profiles reached during the anneal. Between 3.5 to 4.5 Mwh of stored energy in a 15 ft diameter region was released during the pile operation, and the stored energy in that area was reduced to a level where a spontaneous release is now not possible. This was achieved with a maximum fuel element temperature of 275°C and a maximum graphite temperature of 236°C emphasizing the significance of the low temperature method. The peripheral regions of the fuel zone, including the outer three rows, did not reach sufficiently high temperatures for annealing primarily because of sharply dropping thermal gradients at the edges of the moderator stack. The future stored-energy status of the reactor is discussed. (auth)

9587 THE EVALUATION OF WORTH OF CYLINDRICAL CONTROL RODS IN REFLECTED CYLINDRICAL CORES WITH PARTICULAR REFERENCE TO THE O.M.R. L. A. Taylor (Hawker-Siddeley Nuclear Power Co., Ltd., Langley Bucks, Eng.). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 15: 196-9(Dec. 1961).

A calculation is described for predicting control rod worths and radial flux distributions for arrays of cylindrical control rods in reflected cores. The effect on the control rod worths and fluxes of the voids (defined in this article as fuel-free zones containing moderator) that are present in the core as the result of the absence of some of the control rods is also considered. Two-group diffusion theory is used. The computation, which is programmed for MERCURY is used for OMR core calculations and some results are presented. (auth)

9588 THE DESIGN, CONSTRUCTION, AND TESTING OF A PRESTRESSED CONCRETE REACTOR PRESSURE VESSEL MODEL. Arthur Lemprière Lancey Baker (Imperial Coll. of Science and Tech., London), Malcolm Lawrence Anderson Moncrieff, Ian Wilson Hannah, and Stanley Gill. Proc. Inst. Civil Engrs. (London), 20: 555-86 (Dec. 1961).

The design, construction, and pressure testing of a one-sixth-scale model prestressed concrete pressure vessel for containing a reactor are described. Such vessels may ultimately enable the thick-walled steel pressure vessels with independent concrete biological shield, currently used in gas-cooled, graphite-moderated nuclear power stations, to be replaced by a single composite structure. The work demonstrated that such a development is not only feasible, but appears to offer considerable economic advantages, without any diminution of the high safety standards demanded by the industry. (auth)

9589 DYNAMIC BEHAVIOR AND CONTROL OF TWO LOOSELY COUPLED REACTOR SYSTEMS. PARTS I AND II. G. Schweizer. Regelungstechnik, 9: 323-6; 364-7(1961). (In German)

The Argonaut Reactor of the Argonne National Laboratory was loaded with a two slab loading for the experimental study of the dynamics of loose coupled reactor systems. After measuring the dynamics of the two slab loading, the possibilities for the synthesis and the analysis of the control system were studied. It is shown that loose coupled systems which describe to some extent the space-dependent power split of big reactors, can be approached mathematically as multi-loop control systems. (auth)

9590 REACTOR PRESSURE VESSELS OF PRESTRESSED CONCRETE. Radim Servit (Czech Technical Univ., Prague). Tech. Dig. (Prague), 3: No. 4, 28-33 (Apr. 1961). (In English)

The development work in using prestressed concrete for making reactor pressure vessels is discussed. Two types of prestressing are considered: secantial and circular stressing. The research study shows that prestressed concrete is well able to comply with the requirements: transmission of internal gage pressure and heat, and sealing of the reactor. As for biological protection, it is quite obvious that prestressed concrete is satisfactory. Sealing the vessel against permeation by gas is still a problem waiting for solution. Owing to its inherent porosity, concrete is not fit to provide reliable sealing even if the formation of cracks is prevented by prestressing. The inner surface of the reinforced concrete pressure vessel requires, therefore, a protective sealing layer. (N.W.R.)

9591 DIGITAL SIMULATION OF A GAS COOLED REACTOR SYSTEM. Francis Narin and Sidney Singer (Los Alamos Scientific Lab., N. Mex.). Presented at American Rocket Society Space Flight Report to the Nation, New York Coliseum, October 9-15, 1961. [Paper No.] 2119-61. New York, American Rocket Society, 1961.

A FORTRAN II code is written which, in a short amount of computer time, simulates the KIWI-B1A reactor system. This code checks out quite well with analog computer studies of its various parts and with hand computations of steady-state conditions. The code's results seem reasonable in all respects. It is found useful in determining control system constants and for other parametric type studies in the planning of the KIWI-B1A test. (auth)

9592 IMPROVEMENTS IN OR RELATING TO CONTROL APPARATUS FOR NUCLEAR REACTORS. Ronald Hugh Campbell (to United Kingdom Atomic Energy Authority). British Patent 887,392. Jan. 17, 1962.

A reactor control apparatus is described which comprises means for driving a primary control term from a temperature measurement in the core and means for deriving an additional control term from the reactor flux and coolant flow. The two terms are combined to provide a composite control term which is used through a controller to position the control rods automatically. (D.L.C.)

9593 CALANDRIA TYPE SODIUM GRAPHITE NUCLEAR REACTOR. (to U. S. Atomic Energy Commission). British Patent 887,561. Jan. 17, 1958.

An improved sodium graphite reactor core structure of the calandria type is designed as a replacement for the

present Sodium Reactor Experiment (SRE) canned moderator core structure. The structure comprises a sealed core tank, a graphite moderator having unclad outer surfaces in the tank, a plurality of process tubes traversing the tank through the graphite, fuel elements located in the tubes, and protective sleeves between the tubes and the graphite. The advantages of this structure over the present SRE core structure are outlined. (D.L.C.)

9594 IMPROVEMENTS RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Alan Frederick Edward Wise and Peter James McCarthy (to A.E.I.-John Thompson Nuclear Energy Co. Ltd.). British Patent 887,650. Jan. 24, 1962.

A finned reactor fuel element is designed which combines good heat transfer properties with mechanical strength. The fins are shaped in the form of a lattice or honeycomb structure around the canning to induce turbulence in the coolant flow. (D.L.C.)

9595 IMPROVEMENTS IN NUCLEAR FUEL SHEATHS OR CANS AND IN NUCLEAR REACTORS OF THE KIND INCLUDING FUEL ENCLOSED IN CANS. Owen Walter Dumpleton (to Babcock and Wilcox Ltd.). British Patent 887,712. Jan. 24, 1962.

A reactor fuel sheath is designed with fins arranged for optimum heat transfer from the fuel to the coolant. The fins are arranged into an even number of groups of helical fin elements separated by longitudinal channels. The fins are shaped so that a coolant entering one group with a velocity in one direction lengthwise of the can will be moved between the fins to one channel, while a coolant entering an adjacent group with a velocity in the same direction will be moved toward the same channel. Thus, a circulatory movement is imposed on the coolant, improving the heat transfer. (D.L.C.)

9596 IMPROVEMENTS IN NUCLEAR FUEL SHEATHS OR CANS AND IN NUCLEAR REACTORS OF THE KIND INCLUDING FUEL ENCLOSED IN CANS. Jerzy Brzeski and Edwin Charles McKenzie (to Babcock and Wilcox Ltd.). British Patent 887,713. Jan. 24, 1962.

Various fin element designs are described for improving the heat transfer properties of canned reactor fuel elements. (D.L.C.)

9597 IMPROVEMENTS IN HEAT TRANSFER SYSTEMS FOR NUCLEAR REACTORS. Bernard Vrillon and Roland Roche (to Commissariat à l'Energie Atomique). British Patent 887,881. Jan. 24, 1962.

A gas-cooled reactor is designed in which the moderator is heavy water kept at a low temperature. The reactor has fuel rods located in tubular channels in a tank of moderator, and the tubular channels and headers are kept at a moderate temperature by means of internal heat insulation and external cooling means. Thus, the geometry of the reactor does not change and bellows are eliminated in tubular parts subjected to high pressure. (D.L.C.)

9598 NUCLEAR REACTORS. (to U. S. Atomic Energy Commission). British Patent 887,954. Jan. 24, 1962.

A cooling system is designed for gas conduction between a gas-cooled reactor and a steam generator. The system comprises a reactor vessel having an inner section including the reactor core and an outer section forming a thermal shield for the vessel, and two concentric ducts for gas conduction. In operation, relatively cool gas enters the outer section from the outside annulus of the ducts, passes through the core to absorb heat therefrom, and passes out into the internal duct and thence to the steam generator. Thus, thermal stresses are reduced in the steam generator and reactor vessel. (D.L.C.)

9599 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Werner Cautius. British Patent 889,042. Feb. 7, 1962.

A protective installation is designed for containing coolant escaping from gas-cooled reactors. The installation comprises a double protective jacket of concrete surrounding the reactor primary circuit and filled with ammonia. In the event of leakage from the reactor into the jacket, further leakage into the atmosphere can be prevented by injecting water into the ammonia to induce a negative pressure in the jacket relative to the atmosphere. Gas lost by leakage into the jacket may be recovered by simple separation from ammonia. (D.L.C.)

9600 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Kenneth Henry Dent and Harold Howard Gott (to United Kingdom Atomic Energy Authority). British Patent 889,197. Feb. 7, 1962.

A sheathed, finned reactor fuel element is designed with external and internal bracing means of low neutron absorbing material having high creep resistance to resist bowing of the fuel element. The external bracing means comprise longitudinal fins held in contact with the sheath, and the internal bracing means comprise a rod filling the center of the hollow fuel member. The fins may be made from carbon and the rod from sintered alumina. (D.L.C.)

9601 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Everett Long (to United Kingdom Atomic Energy Authority). British Patent 889,200. Feb. 7, 1962.

A gas-cooled reactor with closed circuit cooling is designed with a valve for relieving pressure in the coolant circuit by absorption in a tower. Thus, release of contaminated coolant to the atmosphere is prevented. (D.L.C.)

9602 IMPROVEMENTS IN OR RELATING TO BURST CARTRIDGE DETECTION EQUIPMENT FOR NUCLEAR REACTORS. David John Gibbons (to General Electric Co., Ltd.). British Patent 889,203. Feb. 7, 1962.

Equipment is designed for monitoring coolant samples from reactor fuel channels. The equipment comprises a first monitoring means to monitor a selected group of channels at one sensitivity, a second monitoring means to monitor simultaneously the rest of the channels at a lower sensitivity, and sequence means to cause the first monitoring means to monitor sequentially all of the channels in groups while the remainder are being monitored by the second monitoring means. Thus, the equipment in effect comprises a fine scanning precipitator and a coarse scanning precipitator, the former detecting slow failures and the latter rapid failures. (D.L.C.)

9603 NUCLEAR REACTOR FUEL ELEMENT. C. H. Bassett (to U. S. Atomic Energy Commission). U. S. Patent 3,022,240. Feb. 20, 1962.

A nuclear reactor fuel element of the elongated tubular type is designed wherein cylindrical fissionable ceramic fuel pellets are pressed radially by a spring and wedge disk into tight contact engagement against the inner surface of a tubular housing. The pellets define a central opening and radial passages to facilitate the transfer of heat to the tube and also to provide space to receive fission-product gases. This design has the advantage of facilitating higher burnup of the fissionable material and allows for expansion of the fuel pellets due to high temperature and neutron irradiation. (AEC)

Power Reactors

9604 (ACNP-6124) SHUTDOWN COOLING TEST. Pathfinder Atomic Power Plant Summary Report. W. E. Littleton and W. Ross (Allis-Chalmers Mfg. Co. Nuclear Power Div., Milwaukee). Dec. 15, 1961. For Northern States Power Co., [Minneapolis] and Central Utilities Atomic Power Associates. Dec. 15, 1961. Contract AT (11-1)-589. 45p.

Tests are performed on Pathfinder superheat fuel element mockups, under reactor conditions of 600 psig, in order to determine the parameters influencing heat transfer from the fuel elements to the moderating water under shutdown conditions. The peak temperatures reached by the superheat elements are also found as functions of the heat generation rate. A mathematical model of the heat transfer system is developed. (T.F.H.)

9605 (AECL-1318) PAPERS PRESENTED [AT] THE SEVENTH AECL SYMPOSIUM ON ATOMIC POWER, HELD AT CHALK RIVER, ONTARIO, SEPTEMBER 18 AND 19, 1961. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Sept. 1961. 95p.

Included are eleven papers presented at the Seventh AECL Symposium on Atomic Power. Separate abstracts have been prepared for each of the papers. (B.O.G.)

9606 (AECL-1318(Paper 1)) A DESCRIPTION OF NPD–CANADA'S FIRST NUCLEAR POWER REACTOR. J. L. Olsen (Canadian General Electric Co., Ltd., Toronto). Paper 1 of THE SEVENTH AECL SYMPOSIUM ON ATOMIC POWER. 8p.

The 20 Mw(e) NPD Reactor was designed to demonstrate the potential of nuclear power as a competitive source of energy in the Canadian environment. The description of the NPD includes discussions of the site location, building layout, major equipment and circuits, fuel and fuel handling, the calandria and moderator dump systems, and the control system. (B.O.G.)

9607 (AECL-1318(Paper 2)) IMPLICATIONS OF THE NPD DESIGN. I. N. MacKay (Canadian General Electric Co., Ltd., Toronto). Paper 2 of THE SEVENTH AECL SYMPOSIUM ON ATOMIC POWER. 5p.

The following aspects of the philosophy and the implications of the design are discussed: the safety factors in the engineering design with respect to the strength of steel and Zircaloy; the condensation of steam in the reactor vault in the event of the worst credible accident; the recovery of the heavy water condensed from the steam; the feasibility of using natural uranium as reactor fuel; the versatility of the fuel handling system; and the potentials of the plant design for future developments. (B.O.G.)

9608 (AECL-1318(Paper 3)) SOME OPERATING ASPECTS OF NPD. L. G. McConnell (Ontario. Hydro-electric Power Commission, Toronto). Paper 3 of THE SEVENTH AECL SYMPOSIUM ON ATOMIC POWER. 4p.

The NPD operating aspects are discussed in terms of organization, personnel qualifications, consequences of error, feedback of operating experience, and economics. The operating staff organization chart for the NPD is included. (B.O.G.)

9609 (AECL-1318(Paper 4)) DEVELOPMENT FOR NPD. H. E. Tilbe (Canadian General Electric Co., Ltd., Toronto). Paper 4 of THE SEVENTH AECL SYMPOSIUM ON ATOMIC POWER. 12p.

The discussion of the development work performed for the various components of the NPD reactor plant is given for fuel, lattice site components, and the fuel changing systems. An illustration of the scope of the experimental work for the reactor is included. (B.O.G.)

9610 (AECL-1318(Paper 5)) TRAINING OF NPD STAFF. S. G. Horton (Ontario. Hydro-electric Power Commission, Toronto). Paper 5 of THE SEVENTH AECL SYMPOSIUM ON ATOMIC POWER. 4p.

An outline is given of the training program used in the development of the manpower for the operation of NPD. Sample sheets are included which are from the operator's training manual on typical lessons in radiation protection and station equipment. (B.O.G.)

9611 (AECL-1318(Paper 6)) DOUGLAS POINT PROJECT-PROGRESS. D. L. S. Bate (Atomic Energy of Canada Ltd. Nuclear Power Plant Div., Toronto). Paper 6 of THE SEVENTH AECL SYMPOSIUM ON ATOMIC POWER. 11p.

A discussion is given of the design status and the construction progress of the Douglas Point Project. The design parameters are included. The heat source is a CANDU reactor rated at 694 Mw(t), and the generating station output is 200 Mw(e). The reactor type is natural UO_2 fueled, heavy water cooled and moderated, with a horizontal pressure-tube construction. Entrance and exit coolant conditions are, respectively, 480°F and 1441 psia, and 560°F and 1345 psia. The generating station efficiency is rated at 29.1% over-all. (B.O.G.)

9612 (AECL-1318(Paper 7)) NUCLEAR POWER IN THE HYDRO SYSTEM. H. A. Smith (Atomic Energy of Canada Ltd. Nuclear Power Plant Div., Toronto and Ontario. Hydro-electric Power Commission, Toronto). Paper 7 of THE SEVENTH AECL SYMPOSIUM ON ATOMIC POWER. 6p.

An outline is given of how the characteristics of a Canadian electric utility system are related to the need for and acceptability of the type of nuclear power plant under development in Canada. The total primary load demand in 1960 was 5324 Mw, with a corresponding load factor of 64.3%, while the dependable peak capacity was 5930 Mw. The system primary load growth is such that it is expected that by 1980 the generating capacity requirement will be 21,000 Mw. Economic considerations are given for capital costs of coal-fired thermal plants and hydro-electric plants. The requirements for a nuclear power plant to be suitable in the Ontario Hydro's system are outlined. Basic types of power reactors considered for application in the Ontario Hydro system are graphite-moderated gas-cooled reactors, and light-water moderated and cooled reactors. (B.O.G.)

9613 (AECL-1318(Paper 8)) THE OCDR PROGRAM. W. M. Campbell (Atomic Energy of Canada Ltd., Chalk River, Ont.). Paper 8 of THE SEVENTH AECL SYMPOSIUM ON ATOMIC POWER. 7p.

A review is presented of the OCDR development program, which includes a comparison of the reactor concept with that of the CANDU concept. A comparison is made of the properties of heavy water and organic coolants. Major technical problems occurring in the development studies are discussed for fouling on fuel element surfaces, construction materials, coolant tube development, and uranium carbide fuels. The economic status is such that at present a 200 Mwe reactor is expected to produce power at about 5 mills/kwh. (B.O.G.)

9614 (AECL-1318(Paper 9)) INDUSTRIAL PARTICIPATION IN FUEL DEVELOPMENT IN CANADA. A. J. Mooradian (Atomic Energy of Canada Ltd., Chalk River,

Ont.). Paper 9 of THE SEVENTH AECL SYMPOSIUM ON ATOMIC POWER. 7p.

A description is given of the status of the CANDU fuel development program to illustrate the technical advancements made in the development of a nuclear fuel industry which can stand in competition with the competitors from other countries. A discussion is presented of the proof test experiments conducted of fuel designs prior to the approval of the design for production. (B.O.G.)

9615 (AECL-1318(Paper 10)) FOG COOLED HEAVY WATER MODERATED REACTORS. G. A. Pon (Atomic Energy of Canada Ltd., Chalk River, Ont.). Paper 10 of THE SEVENTH AECL SYMPOSIUM ON ATOMIC POWER. 11p.

A discussion is given of the progress made in the assessment of the fog-cooled concept toward determining the feasibility and the potentiality of success for eventually replacing the CANDU type reactor. The various flow and heat transfer regimes are described which are possible in a uniformly heated pipe with water flowing in and steam flowing out. The main advantages of the concept are listed. The economic study of the concept is summarized in terms of pressure tube system, fuel, reactor core, power plant cycle, parametric study, reference code, cost comparison with CANDU, potentials for future development, areas of doubt, and the Chalk River study. (B.O.G.)

9616 (AECL-1318(Paper 11)) LONG TERM PROSPECTS FOR COMPETITIVE NUCLEAR POWER. W. B. Lewis (Atomic Energy of Canada Ltd., Chalk River, Ont.). Paper 11 of THE SEVENTH AECL SYMPOSIUM ON ATOMIC POWER. 10p.

The discussion of the future prospects is given in terms of neutron economy and the fuel conversion ratio, the fuel fabrication costs, the reactivity change between fueling operations, the fuel power rating of the U-235, and thermal efficiency. Methods applicable to increasing the neutron economy, reactivity, power rating, and thermal efficiency and for decreasing the fuel fabrication costs are included. (B.O.G.)

9617 (ANL-6469) NUCLEAR REACTOR HEAT TRANSFER. Paul A. Lottes (Argonne National Lab., Ill.). Dec. 1961. Contract W-31-109-eng-38. 201p.

Text material for a graduate course in heat transfer applications to nuclear engineering is presented. Topics covered include fuel element heat transfer-steady state, fuel assembly calculations, maximum-to-average heat flux calculations, hot spot factors, power excursion equations, fuel element transients, shutdown cooling calculations, shield cooling calculations, boiling heat transfer-steady state, two-phase pressure drop with constant flow area, two-phase density and slip ratio, expansion losses with two-phase flow, contraction losses with two-phase flow, hydrodynamic analysis of a natural-circulation circuit, flow in parallel channels, calculation of boiling length, and calculation for a boiling reactor core. (M.C.G.)

9618 (APAE-97) INVESTIGATION OF 17-4 PH STEEL COMPONENTS USED IN SM-1, SM-1A, PM-2A REACTOR PLANTS. E. S. Haraway and R. M. Saccocio (Alco Products, Inc., Schenectady, N. Y.). Jan. 23, 1962. Contract AT(30-1)-2639. 77p.

An investigation was made of 17-4 PH steel components used in the SM-1, SM-1A, and PM-2A nuclear power plants, which consist of control rod drive racks, pinions, seal shafts, and associated parts. Evidence supporting the continued use of 17-4 PH steel in these applications is presented. Alco's current procurement and processing specifications for 17-4 PH steel are included. The evidence presented is in the form of stress calculations, test and environmental data, and the results of non-destructive and destructive metallographic analyses. (auth)

9619 (APAE-100) NUCLEAR MEASUREMENTS FOR TYPE 3 REPLACEMENT CORES FOR SM-1, SM-1A AND PM-2A CE-3. T. M. Raby, L. D. Walthousen, S. N. Kemp, W. J. McCool, K. C. Sontheimer, and R. A. Robinson (Alco Products, Inc., Schenectady, N. Y.). Jan. 11, 1962. Contract AT(30-1)-2639. 150p.

Description and results are given of an experimental program to evaluate the effect of utilizing Type 3 (SM-2) replacement cores in existing Army field plants SM-1, SM-1A, and PM-2A. SM-2 mockup fuel elements similar in composition to Type 3 fuel elements were employed to determine startup characteristics of Type 3 cores in SM-1, SM-1A, and PM-2A core configurations. Measurements include comprehensive power distribution, temperature coefficients, initial critical bank positions, control rod calibrations, critical rod configurations, and material coefficients, all obtained under cold and clean core conditions. The 45-element SM-1 and SM-1A configurations with SM-2 mockup fuel elements contain 36.4 kg U^{235} and an estimated 67.9 g B^{10}, while the 37-element PM-2A configuration with SM-2 mockup elements contains 30.0 kg U^{235} and an estimated 56 g B^{10}. (auth)

9620 (APAE-Memo-299) SUPPORTING ANALYSIS FOR THERMAL SUITABILITY OF FUEL ELEMENTS FOR SM-1A CORE I LOADING. J. O. Brondel (Alco Products, Inc., Schenectady, N. Y.). Jan. 10, 1962. Contract AT (30-1)-2639. 41p.

A recommended SM-1A Core I loading chart was derived from available, metallurgically acceptable elements at the SM-1A and SM-1 sites. The derivation was based on local thermal and hydraulic considerations of minimum element-to-element coolant channel clearances. These clearances were determined from field inspection measurements of outer fuel plate spacing, as modified by analytical calculations of plate ripple growth during exposure to reactor operating thermal stresses. (auth)

9621 (CENC-1032) STRUCTURAL ANALYSIS OF S5W STEAM GENERATOR. R. H. Billingsley, Jr. and W. I. Juntunen (Combustion Engineering, Inc. Nuclear Components Dept., Chattanooga). Aug. 1958. CE Contract 15857. 178p.

The structural integrity of the S5W steam generator was established by the results of analyses which are described. (auth)

9622 (CEND-118) FABRICATION OF SUPERHEATER FUEL ROD ASSEMBLIES FOR BONUS CRITICAL EXPERIMENTS. (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Jan. 3, 1961. Contract AT(11-1)-795. 32p.

The BONUS critical fuel rods incorporate an enriched UO_2 fuel pellet stack encased in a stainless steel tubular sheath and sealed at both ends by a solid plug welded to the cladding tube. The techniques and procedures involved in the fabrication of the components are outlined. Inspection procedures are described. Of the 900 fuel rods started in production 888 were shipped as acceptable components. The rejected components contained the same defect: a leak in the tube wall located several inches above the bottom plug weld. (M.C.G.)

9623 (CEND-151) ABWR QUARTERLY PROGRESS REPORT, OCTOBER 1 THROUGH DECEMBER 31, 1961, [ON] DESIGN AND DEVELOPMENT. (Combustion Engi-

neering, Inc. Nuclear Div., Windsor, Conn.). Jan. 15, 1962. Contract AT(11-1)-1062. 57p.

Design and development activities related to the Army Boiling Water Reactor Program are summarized. Development and evaluation are reported on control rod drive mechanisms, plant simulation, core assemblies, control rods, and PL production fuel elements. Completion of the refueling equipment design is reported, and design of the radioactive gas handling equipment is in progress. A primary shield analysis is in progress. A draft of the startup procedure was prepared and a procedure for shutdown is being written. The status of the facility design and fabrication is reported along with development of an experimental program. Data are also given for comparison of the mock-up and PL-2 cores. (J.R.D.)

9624 (CUA-NE-17) SIMULATED NUCLEAR REACTOR VIBRATIONAL HEAT TRANSFER. Quarterly Progress Report, May 1, 1961–July 31, 1961. (Catholic Univ. of America, Washington, D. C.). Contract AT(30-1)2655. 13p.

Activities in a program to design and build a vibrational heat transfer test section are reported. Progress during the report period includes installation and initial operation of the heat transfer loop, the electrodynamic shaker, and establishment of a pool heating program in which a tubular heater is mechanically vibrated by the shaker. Other activities included procurement of equipment, and development of a probe for use in measuring surface temperatures during pressurized, convective heat transfer tests in the loop without water flow disturbance. (J.R.D.)

9625 (DC-57-12-710) INSERT 1-B POST OPERATIONAL EXAMINATION. SECOND INTERIM REPORT. Dale E. Johnson and D. C. Durrill (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 11, 1957. Contract AT(11-1)-171. 62p.

A report is presented containing post-irradiation metallurgical observations and photographs of hydrided zirconium moderator blocks from the 1-B insert and bore gage dimensions from block no. 4 of the 1-B insert. (auth)

9626 (DC-58-1-191) INVESTIGATION OF THERMAL EXPANSION PROBLEMS IN P-102 MODERATOR. R. G. Cook and L. E. Eckart (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 14, 1958. Contract AT(11-1)-171. 27p.

An investigation of the thermal expansion between the support tube assembly and moderator in the unclad P-102 Reactor was conducted. Isothermal temperature conditions, such as would be present in the hot critical experiment, and reactor operating temperature conditions were considered and data on the thermal expansion coefficient of zirconium hydride were obtained. (auth)

9627 (DC-58-2-118) 102 PROJECT DATA BOOK. Sixth Issue. M. Schoenberger (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 14, 1958. Contract AT(11-1)-171. 399p.

Reference information is included for the D102-A Assembly, which consists of a solid hydrided zirconium moderator reactor, nichrome fuel elements, primary flight-type shield, external auxiliary shielding, engine-reactor ducting, single chemical combustor, assessories and turbojet engines. The information is given in terms of nuclear and thermodynamic design, shield, engines and combustor, structure, accessories, remote handling, reactor, controls and instrumentation, and heated critical experiment. (B.O.G.)

9628 (DC-58-4-152) NUCLEAR DESIGN OF THE SHIELD TEST AIR REACTOR. W. L. Orr (General Electric Co. Aircraft Nuclear Propulsion Dept. Cincinnati). Feb. 15, 1958. Contract AT(11-1)-171. 26p.

The nuclear design is presented for the reactor core configuration to be used in Shield Test Air Facility at the Idaho Test Station. The basic methods of analysis and their relationship to previous experimental results are given in detail. (auth)

9629 (DCL-59-5-216) D101-L2F-1 THERMODYNAMIC ANALYSIS. K. L. Adler (General Electric Co. Aircraft Nuclear Propulsion Dept. Cincinnati). May 18, 1959. Contract AT(11-1)-171. 9p.

An analysis of an increase in D101-L2F-1 cartridge power of 40 kw at a 10-Mw reactor power is presented. Included are data from steady state and transient analyses related to a 10% increase in maximum fuel plate temperature. (J.R.D.)

9630 (DCP-59-471) FRONT AND REAR PLUG STUDIES. Final Report. Hugo J. Nielsen and I. B. Fieldhouse (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Feb. 2, 1959. For General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Contract AT(11-1)-171, Subcontract AT-91-9. 143p.

Temperature patterns in various parts of the front and rear shield plugs were calculated for steady state operating conditions. A transient analysis was also made of the front plug for the case of sudden cut off of reactor power and for an assumed start up condition. (auth)

9631 (DLCS-1480116) CORE I CONTROL ROD DRIVE MECHANISM PERIODIC TEST. CORE I, SEED 2. Test Evaluation (T-550011-E). Section 1. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 4, 1962. Contract [AT(11-1)-292]. 16p.

Tests were carried out to determine the operating condition of the rod drive mechanisms so that operating personnel may be informed about any malfunctioning mechanisms. The scram times measured during this test varied from a maximum of 1.138 sec to a minimum of 1.032 sec. No noticeable difference in the scram times from the effects of reactor coolant temperature, reactor coolant pressure, controlling rod group or core location were observed. The effects of the reactor coolant flow, purification service, and total rod motion were observed. (M.C.G.)

9632 (DLCS-2150201) CORE REMOVAL COOLING SYSTEM–SECTION II. CORE I, SEED I. Test Results T-641113. Section 2. (Duquesne Light Co., Shippingport, Penna.). First issue, May 19, 1961. 31p.

A test was performed on June 19, 1959 to determine the capacity of the Core Removal Cooling System for removing reactor decay heat under "split-flow" conditions. The system operated satisfactorily during this test; the pumps developed a flow of ~73 gpm at a total head of 254 ft water, as compared with their rated capacity of 75 gpm at a total head of 250 ft water. (D.L.C.)

9633 (DLCS-3070103) PRIMARY PLANT SELF-ACTUATED RELIEF VALVE OPERATION. CORE I, SEED 3. Test Evaluation. Section 1. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 25, 1962. Contract [AT(11-1)-292]. 16p.

Tests were carried out on the self-actuated reactor relief valves and the self-actuated pressurizer steam relief valves in order to insure their reliable operation. The valves operated properly, and the final set pressures were all within the specified limits. (D.L.C.)

9634 (DLCS-3170102) DETERMINATION OF RADIATION CONTAMINATION LEVELS DURING CORE I, SEED 2–SEED 3 REFUELING OPERATIONS. Test Evaluation (T-643128). (Duquesne Light Co., Shippingport, Penna.). First issue, Feb. 2, 1962. Contract [AT(11-1)-292. 36p.

A record is presented of radiation contamination levels observed in the work area during the Core I, Seed 2-Seed 3 refueling operations. The radiation levels for Seed 2-3 refueling were somewhat higher than those for Seed 1-2 refueling in certain areas and are ascribed to operations being carried out under dry conditions. Maximum contamination levels were also higher, but the general contamination level was lower. The activity of canal water was higher and characterization was made on some of the canal water samples. (D.L.C.)

9635 (DLCS-3370103) PERIODIC CALIBRATION OF REACTOR PLANT FLOW INSTRUMENTATION. CORE I, SEED 3. Test Evaluation. Section 1. (Duquesne Light Co., Shippingport, Penna.). First issue, Feb. 2, 1962. Contract [AT(11-1)-292]. 53p.

A test was made to determine and correct any calibration drift in the Reactor Plant Coolant Loop flow, Purification Loop flow, Fill Pump Suction flow, and FEDAL sample flow instrumentation, and to scale the Data Acquisition System for Coolant Loop flows and Purification Loop flows. The calibration of all instrument trains was considered acceptable with the exception of the 1D Reactor Coolant Loop Flow instrument train, which exhibited a large amount of hysteresis. The Fill Pump Suction flow was the only instrument train to be calibrated within 1% of full scale at all calibration points. (D.L.C.)

9636 (DLCS-3380102) CALIBRATION OF CORE FLOW INSTRUMENTATION. CORE I, SEED 3. Test Evaluation. (Duquesne Light Co., Shippingport, Penna.). First issue, Feb. 1, 1962. Contract [AT(11-1)-292]. 46p.

Tests were performed to determine and correct any calibration drift in 13 selected instrument trains in the core flow instrumentation. Four instrument trains could not be calibrated and alternate instruments were calibrated in their place. The remaining instrument trains and the 4 alternates were calibrated to within 1.25% of full range at 60, 80, and 100% flow. (M.C.G.)

9637 (DLCS-3420104) PERIODIC CALIBRATION OF REACTOR PLANT DIFFERENTIAL PRESSURE INSTRUMENTATION. CORE I, SEED 3. Test Evaluation. Section 1. (Duquesne Light Co., Shippingport, Penna.). First issue, Feb. 2, 1962. Contract [AT(11-1)-292]. 32p.

Tests were carried out to determine the magnitude of and to correct any errors or drift in the reactor coolant pump differential pressure instrumentation, heat exchanger differential pressure instrumentation, and reactor vessel differential pressure instrumentation. The instrumentation was calibrated to the specified or best possible accuracy. (M.C.G.)

9638 (DLCS-3430102) PERIODIC CALIBRATION OF LEVEL INSTRUMENTATION. CORE I, SEED 2. Test Evaluation (T-643721). (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 5, 1962. Contract [AT(11-1)-292]. 46p.

Tests were performed to determine and correct any calibration drift or error in the following water level instrumentation: pressurizer level, valve operating water flask level, flash tank level, component cooling water expansion tank level, blow-off tank level, and neutron shield tank level. All instruments were successfully calibrated to within ±1% of span over the normal operating range. (M.C.G.)

9639 (DLCS-3430103) PERIODIC CALIBRATION OF LEVEL INSTRUMENTATION. CORE I, SEED 3. Test Evaluation. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 29, 1962. 54p. Contract [AT(11-1)-292].

A test was made to determine and correct any calibration drift in the water level instrumentation and to scale the Data Acquisition System for the pressurizer level instrumentation. All the level instrumentation except the pressurizer level was calibrated to the required accuracy. The pressurizer level instrumentation was calibrated to the specified accuracy over the normal operating range. (D.L.C.)

9640 (DLCS-3570104) REACTOR PLANT CONTAINER INTEGRITY TEST (AIR LOCK TEST). Test Evaluation. Section 1. (Duquesne Light Co., Shippingport, Penna.). First issue, Dec. 26, 1961. Contract [AT (11-1)-292]. 11p.

Tests were carried out to prove the integrity of each of the six reactor plant container air locks. Each air lock, with both doors closed and the inner equalizing valves plugged, was pressurized with service air to a pressure of 58 psig. The air lock leakage rate was observed by recording the pressure drop. The leaks were located by performing a soap bubble test on all penetrations into the air lock. Maintenance was performed on the points of leakage. The final leak rates for each of the six air locks were within the maximum permissible leak rate of 0.8 psi/hr. (M.C.G.)

9641 (DP-685) HEAVY WATER MODERATED POWER REACTORS PROGRESS REPORT, NOVEMBER 1961. R. R. Hodd and L. Isakoff, comps. (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). Dec. 1961. Contract AT(07-2)-1. 30p.

Pre-startup operation of the Heavy Water Components Test Reactor (HWCTR) continued throughout November 1961. Hydraulic testing of the main D_2O system of the reactor was progressing satisfactorily with light water. A résumé is presented of experimental data obtained at the Savannah River Laboratory on the bucklings of natural uranium oxide rods in heavy water. The thermal neutron diffusion coefficient for heavy water was measured as a function of temperature from 20 to 220°C. The measurements agreed with theoretical predictions. At the end of the month, fabrication of 15 sets of thin-walled tubes of uranium metal for irradiation tests in the HWCTR was 85% complete. Further experimental data are reported on heat transfer limits for a single rod cooled by forced flow of boiling water at 1000 psia. (auth)

9642 (GA-1954) MARITIME GAS-COOLED REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING DECEMBER 31, 1960. (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Contract AT(04-3)-187. 159p.

Progress in the MGCR project incorporating the development of the Beryllium Oxide Reactor Experiment is described. Reactor development, fluid systems and plant arrangement, rotating machinery, reactor physics, materials development, and site development are discussed. (M.C.G.)

9643 (GA-2684) A DYNAMIC MODEL OF THE HIGH-TEMPERATURE GAS-COOLED REACTOR. R. W. Schlicht (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Jan. 18, 1962. Contract AT(04-3)-314. 13p.

Presented at the Western Simulation Council Meeting held at General Atomic on January 18, 1962.

Simulation of the HTGR is effected through the use of

approximately 160 amplifiers, 16 multipliers, 4 diode-function generators, and various coefficient potentiometers, function switches, and comparator relays. The simulation of neutron kinetics, reactor-core thermal transfer, helium transport, steam-generator heat transfer, and the control system is discussed. The model was used to demonstrate the load-following capabilities of the plant at the normal required controlled rate of 3%/min. Basic control criteria and controller ranges were established. (M.C.G.)

9644 (GAMD-1370) HTGR REACTOR SHIELD ESTIMATE. V. Luco (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Mar. 4, 1960. Contract AT(04-3)-314. 23p.

Radiation dose rates are estimated as functions of the thickness of the concrete biological shield of the Peach Bottom Power Reactor. Points on the midplane of the reactor core, on the outer face of the concrete shield, are considered. Contributions to the dose rate come from fast neutrons and γ rays from the core, and capture γ rays from the thermal shield, reflector, and concrete. Each contribution is analyzed separately. (auth)

9645 (GAMD-1454) LOCATION OF FAILED FUEL ELEMENTS IN THE HTGR. R. F. Turner and F. E. Vanslager (General Atomic Div., General Dynamics Corp., San Diego, Calif.). June 9, 1960. Contract AT(04-3)-314. 14p.

A discussion is given of the advantages and problems of two methods under consideration for the detection of defective fuel elements in the HTGR core. One method involves sniffing the top of the core to locate an increase in activity emerging from a broken element, while the other involves monitoring flow rates in the purge lines leading from individual fuel elements. (B.O.G.)

9646 (GEAP-3567) EFFECTS OF VERTICAL GRAVITY OSCILLATIONS ON PERFORMANCE OF THE T7 NATURAL CIRCULATION BOILING WATER REACTOR. G. R. Pflasterer, Jr. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). June 14, 1961. Contract AT(04-3)-189. 54p.

Results are presented from an analog computer study of the transient behavior of a natural-circulation boiling-water reactor propulsion system in the T7 tanker under conditions of ship's motion. The studies utilized an analog model which is improved over that used in work reported earlier (GEAP 3294). The ship's motion was simulated as a sinusoidal variation in vertical acceleration. The response of the reactor model was determined including flow, void content, reactivity, power, fuel temperature, and reactor steam pressure. The frequency and amplitude of the sinusoidal acceleration were varied. Effects of different simulation techniques on the reactor model response were determined. (auth)

9647 (GEAP-3778) A SIMULATED SUPERHEAT REACTOR CORROSION FACILITY. M. D. Fitzsimmons, W. L. Pearl, and M. Siegler (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Aug. 14, 1961. Contract AT(04-3)-189. 48p.

The design and principles of operation of a superheat facility developed to meet the needs of versatile out-of-pile superheat corrosion testing are described. A boiling corrosion loop was modified for use as the facility. The superheated steam flow system, system control and instrumentation, electrical system, safety system, sampling and analytical system, startup procedures, shakedown run, oxygen and hydrogen recombination, heater extractor, operation, and test programs are discussed. (M.C.G.)

9648 (GNEC-156) WATER INJECTION TEST SIMULATING MODERATOR FLOODING OF BONUS SUPERHEATER ASSEMBLY. Terminal Report under Activity No. 50-00-00, Heat-Transfer Tests Simulating Loss of Coolant. (General Nuclear Engineering Corp., Dunedin, Fla.). Feb. 15, 1961. Contract AT(11-1)-795. 37p.

Tests are performed to simulate sudden and extensive exposure of the BONUS superheater fuel elements to the moderating water, in order to determine whether the time delay between exposure and flooding is dangerously short (i.e., on the order of a few msec). Flooding is assumed to be complete when two-phase flow is established at the outlet of the superheater assembly. Tests on one- and four-pass test rigs show that the time required for two-phase flow to be established is on the order of a few sec. The flow passes fairly smoothly from steam flow to fog flow to two-phase flow. (T.F.H.)

9649 (GNEC-192) BONUS SUPERHEATER ASSEMBLY SEAL CONNECTOR DEVELOPMENT. Terminal Report Under Activity No. 60-00-00, Insulation and Seal Connector Development. (General Nuclear Engineering Corp., Dunedin, Fla.). Sept. 11, 1961. Contract AT(11-1)-795. 70p.

The design of the seals used in the BONUS reactor at the junctures between the superheater steam connector pipes and various dryers, headers, and standpipes is described. The seals for the inlet and outlet steam lines are identical. The design requirements as to accessibility, performance, replaceability, and repairability are discussed. (T.F.H.)

9650 (HPR-15) OECD HALDEN REACTOR PROJECT. H.B.W.R. QUARTERLY PROGRESS REPORT, JULY TO SEPTEMBER 1961. (Norway. Institutt for Atomenergi. OECD Halden Reaktor Prosjekt). 91p.

The reactor was shut down for the entire reporting period, for reactor modifications and removal and storage of the first fuel charge. The analysis of static and dynamic reactor physics experiments performed with the first fuel charge was described, with particular reference to void reactivity coefficient determinations. Apparatus for mechanical and nuclear measurements in the reactor core was designed. Engineering aspects of the operation with the second fuel charge were reviewed. (T.F.H.)

9651 (HW-68596) DESIGN TEST 1067—NPR PRIMARY LOOP EMERGENCY DUMP TESTS. PHASE II. TEST REPORT. R. J. Robinson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 10, 1962. Contract AT(45-1)-1350. 36p.

A total of 22 dump tests were run using the facilities of the NPR-PCE Loop in the 189-D building. These were divided into 12 series I tests, to establish quench tank design requirements and maximum safe quench water temperature limit after dumping, and 10 Series II tests, to evaluate various distributor designs. Pressurized water varying in temperature from 600 to 275°F, simulating the conditions applying to the primary loop and the initial once-through cooling water respectively, was dumped into a pool of quench water. In all cases the recorded data and visual observations showed that: quench tank vibrations were negligible for all high temperature tests and for the low temperature tests using the ring and draft tube distributors; agitation and mixing were adequate with all of the distributors; condensation of the pressurized water was complete in all of the tests; and examination of the concrete quench pit after these tests revealed no damage. (auth)

9652 (IDO-16726) QUARTERLY TECHNICAL REPORT [ON] SPERT PROJECT, JULY, AUGUST, SEPTEMBER 1961. F. Schroeder, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Dec. 15, 1961. Contract AT(10-1)-205. 32p.

The kinetic behavior of a 4%-enriched UO_2-pin-fueled water-moderated core in Spert I is investigated. Both step and ramp transients are applied, and the pins may be either free to bow or constrained to remain straight. Power excursion tests are performed in Spert II, in order to investigate the response of a D_2O-moderated core to step reactivity insertions at room temperature and at initial system pressures of 15 to 375 psig. The effects of initial system temperature and subcooling on the system response to step reactivity insertions are studied in Spert III. In addition, the hydraulic characteristics of the fuel plate assembly used in Spert II are examined. (T.F.H.)

9653 (KAPL-2000-16) REACTOR TECHNOLOGY REPORT NO. 19—PHYSICS. (Knolls Atomic Power Lab., Schenectady, N. Y.). Dec. 1961. Contract W-31-109-Eng-52. 192p.

Nuclear Cross Sections. The resonance integrals of Mn, Hf, and Nb were measured. The mass spectrometer filament enrichment technique was used to determine the Sm^{149} effective activation cross section. The $O^{16}(n,p)$ cross section was measured as a function of neutron energy from 12.5 to 16.5 Mev. The $F^{19}(p,\alpha\gamma)$ reaction was used to calibrate a 1-Mev Cockcroft-Walton accelerator used to accelerate deuterons for producing neutrons. ABACUS, a computer program for cross-section calculations, is described. ABACUS was used to calculate the optical model parameters of the angular distributions of neutrons scattered from Zr^{90} at 0.25 to 7 Mev. Methods are described for calculating elastic and inelastic differential cross sections, angular momentum coupling coefficients, and compound nucleus effects in neutron capture. Results are given for the development of a satisfactory potential function in the direct interaction model. Photoneutron production calculations for Be^9 and C^{13} were extended to an energy range $E_\gamma \approx 3$ Mev. Computational work on the cross section of the thermal neutron scattering by water and polyethylene is described. Neutron Spectra and Fluxes. The thermal neutron scattering kernels were used in calculating neutron spectra in both infinite homogeneous media and lattices. Computer programs for the calculation of neutron spectra are described, e.g., TET, TRANSWAKRUM, and TRAM. The application of variational techniques to linear systems is discussed. Few-Group Parameters: Criticality. A two-mode variational procedure was developed for calculating fast-group diffusion theory parameters. In the variational calculation of thermal spectra, it is shown that the advantages of symmetrization of the scattering kernel are nil. Methods are given for computation of spectrum-averaged cross sections. The temperature dependence of the thermal diffusion length in paraffin was measured and used to derive transport cross sections. The cross sections for fission products were examined in detail with respect to their poisoning effect on reactor cores, and it is concluded that, while uncertainties in current data give small errors, the assumption that stable products are formed directly in the fission process can lead to significant errors. Variation calculation of the reactivity k is discussed. Reactor Kinetics. The method for calculating the effect of neutron population fluctuations on reactor design was extended to account for the actual nonzero lifetime of prompt neutrons. A semi-direct variational method is given for solving the space-time neutron multigroup kinetic equations for reactor analysis. (D.L.C.)

9654 (MND-M-1821) PM-1 NUCLEAR POWER PLANT PROGRAM. 10th Quarterly Progress Report, June 1, 1961 to August 31, 1961. (Martin Co. Nuclear Div., Baltimore). Oct. 3, 1961. 60p. Contract AT(30-1)-2345.

A description is given of development and fabrication work done on the PM-1 reactor, a 1-Mw(e) prepackaged air-transportable nuclear power plant. The principal efforts were concerned with fuel element irradiation testing, fuel element and control rod development, plant fabrication and shipment, and plant installation. (D.L.C.)

9655 (MND-M-2583) EVALUATION AND RESULTS OF THE IRRADIATION TESTING OF THE PM-1-M FUEL ELEMENT. (Martin Co. Nuclear Div., Baltimore). June 1961. Contract AT(30-1)-2345. 203p.

The irradiation failure of two PM-1-type fuel elements has been evaluated and analyzed. Failure was caused by formation of blisters from water penetrating through fuel tube end seam openings, migration of water through permeable UO_2–stainless steel cermet and subsequent steam formation within the cermet during irradiation. Methods for closing fuel tube end and eliminating cermet porosity have been investigated. Welding of longitudinal fuel tube dead end core seams prior to cladding of the fuel tube has been shown to provide an adequate end closure. An extensive series of parametric fabrication process changes have been investigated and evaluated to eliminate cermet porosity. Hot reduction of stainless steel enveloped, cold rolled, cermet strip prior to fuel tube core formation, together with hot isostatic pressing of assembled fuel tubes, has been shown to eliminate cermet porosity in addition to providing double clad integrity. Fuel tubes fabricated using these process techniques have been irradiated for an integrated exposure of 10 times that of the failed fuel tubes. Post irradiation examination has shown no evidence of failure. The effects of fuel tube parametric fabrication changes on the nuclear, thermal, and hydraulic characteristics of the PM-1 core have been shown to be small and easily accounted for. (auth)

9656 (MND-M3A-2451) PM-3A NUCLEAR POWER PLANT PROGRAM. Fourth Quarterly Progress Report, May 16, 1961 to August 15, 1961. (Martin Co. Nuclear Div., Baltimore). Contract AT(30-1)-2700. 52p.

Progress is reported for the design, fabrication, assembly, and testing of the PM-3A plant. The primary system assembly is 90% complete. (D.L.C.)

9657 (NAA-SR-1109) SODIUM GRAPHITE REACTOR. Quarterly Progress Report, July–September 1954. Sidney Siegel and Guy M. Inman, eds. (North American Aviation, Inc., Downey, Calif.). Dec. 1, 1954. Contract AT-11-1-GEN-8. 101p.

Technology of the Sodium Graphite Reactor. Reactivity calculations were made to study the application of steady-state plutonium feedback techniques to the use of diffusion plant tails for reactor fuel feed material. The performance and design of a twin core SGR power plant are given. Thermal neutron flux distribution measurements are reported for a six-rod fuel cluster and for a hollow uranium rod. A power cost calculation was made for a 1000-Mw SGR Th–U^{233} breeder reactor which starts up on Th–U^{235} alloy. Calculations were made on neutron leakage through the SRE shield. Research on reactor fuel elements and reactor materials are described. Corrosion and irradiation damage data at 5×10^7 r dose (150°F) on toluene as the SRE shield coolant indicate that the radioinduced corrosion of Fe, Al, and Cu in the SRE shield should be negligible. Preliminary results are summarized for 1-Mev electron ir-

radiation studies of terphenyls at 400 to 450°C. Sodium Reactor Experiment. Progress is reported for various portions of the SRE project: reactor design and evaluation, fuel elements, moderator, reflector, structure, reactor cooling and heat transfer, instrumentation and control, shielding, and reactor services. (D.L.C.)

9658 (NAA-SR-5416) KINETIC EXPERIMENTS ON WATER BOILERS—"A" CORE REPORT—PART II. ANALYSIS OF RESULTS. M. Dunenfeld, comp. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 1, 1962. Contract AT-11-1-GEN-8. 65p.

The status of the analytic portion of the KEWB program at the time of completion of the spherical core experiments is summarized. Three computer programs were developed for use in this analytic effort. The first reassembles and smooths three decades of reactor power data read separately from oscillogram records of reactor excursions. It then computes the logarithmic derivative of the power, energy release, fuel solution temperature, and temperature compensated reactivity. The second program utilizes the space-independent neutron kinetics equations with any number of delayed neutron groups to determine the reactivity in the reactor from the power and its derivative. The third program solves the space-independent kinetics equations for the neutron flux from an input reactivity or initial period. Up to 50 reactivity feedback equations including delayed neutrons are provided for in this program. A mathematical model of the reactor investigated extensively was one containing six delayed neutron groups, conventional treatment of temperature reactivity compensation, and void compensation of reactivity induced by radiolytic gas void growth proportional to the product of reactor power and energy release. Partial mathematical solutions to the kinetic equations were derived for reactivity feedback proportional to prompt temperature and void growth according to the product of power and energy. These solutions apply where delayed neutrons can be neglected, which is the region of major interest. Expressions are available relating power and energy and defining the peak power and energy release to peak power in terms of basic reactor parameters. Experimental evidence, particularly the experimental inhour curve, of another reactivity influencing mechanism was found present in the reactor at periods shorter than 10 msec. This mechanism was shown to behave as a delayed neutron group, having a mean delay time of approximately 2 msec and an abundance of 2%. A plausible origin of such neutrons was shown to be the reflector which thermalizes core neutrons and returns them to the core following a delay. (auth)

9659 (NDA-2131-44) HEAVY WATER-MODERATED POWER REACTOR PROGRAM. Quarterly Progress Report for Period Ending December 31, 1961. (United Nuclear Corp. Development Div., White Plains, N. Y.). Dec. 31, 1961. Contract AT(30-1)-2836. 24p.

Experimental reactivity data were accumulated through operation of the Pawling Lattice Test Rig. The systematic error in k_∞ measurements resulting from absorptions in the aluminum can bounding the test region was evaluated experimentally. The reasons for conducting these tests and the correction factors obtained are presented. Corrected data for the UO_2 19-rod calibration lattice and the 37-rod measurements at 11.1 in. lattice pitch are tabulated. The k_∞ and f measurements are presented for a bare 37-rod cluster of $\frac{1}{2}$ in. UO_2 rods on a 10.46 in. lattice pitch in addition to other configurations of tubular fuel. A major improvement in the precision and accuracy of void coefficient measurements was effected with the tubular fuel configurations by remotely filling or voiding the coolant channels. The results of these experiments with the B'C' fuel element on 11.1 in. lattice pitch are given. (auth)

9660 (NMI-7241) POWER REACTOR PROGRAM. Progress Report to Savannah River Operations Office, United States Atomic Energy Commission for the Period June 1, 1961 through July 31, 1961. S. Isserow, R. W. Anderson, W. J. Richmond, and E. F. Jordan (Nuclear Metals, Inc., Concord, Mass.). Aug. 24, 1961. Contract AT(30-1)-1565. 17p.

Processing of a demonstration set of three unalloyed uranium outer tubes showed that a process is available to produce the initial loading of outer tubes for the HWCTR. Two 2-inch tubes were extruded for the study of the effect of restraint on fuel swelling during irradiation. Post-extrusion evaluation is proceeding on these 2-inch tubes and on 1-inch tubes that were extruded previously. A program has been initiated to prepare outer tubes with cores of U−1 wt % Si and U−0.3 wt % Al−0.5 wt % Si. (B.O.G.)

9661 (NP-11295) SM-1A PROJECT—TECHNICAL MANUAL: CHEMISTRY. Julius Chupak (Alco Products, Inc., Schenectady). Sept. 29, 1960. For Kiewit (Peter) Son's Co., Delta Junction, Alaska. Contract DA-95-507-13106-1116, Subcontract DA-1116-1. 25p. (AP Note 284).

A manual is given of the equipment and procedures used in the Army Reactor (SM-1A) to control the water purity and makeup. In addition to a description of the primary purification control system, a discussion is presented of the water chemistry control procedures for the auxiliary systems (e.g., the spent-fuel pit, the shield tank, and the waste disposal system). (T.F.H.)

9662 (NP-11296) ANALYTICAL CHEMISTRY PROCEDURES PRIMARY SYSTEM WATER CONTROL, SM-1A PROJECT. Julius Chupak (Alco Products, Inc., Schenectady, N. Y.). Sept. 29, 1960. For Kiewit (Peter) Son's Co., Delta Junction, Alaska. Contract DA-95-507-Eng-1116, Subcontract DA-1116-1. 42p. (AP Note 283).

Analytical procedures are described for routine determinations of chlorides, oxygen, total and suspended solids, ammonia, hydrazine, iron, and iodine (fission-product) in the water of the Army Reactor (SM-1A) primary water system. Measurements of the pH and conductivity of this water are also described. (T.F.H.)

9663 (NYO-9064) FUEL ELEMENT DEVELOPMENT PROGRAM FOR THE PEBBLE BED REACTOR. Final Report. (Sanderson and Porter, New York). Apr. 30, 1961. Changed from OFFICIAL USE ONLY Aug. 18, 1961. Contract AT(30-1)-2378. 215p.

The basic fuel element consisted of a uniform dispersion of fuel in a $1\frac{1}{2}$ inch diameter graphite sphere. Ceramic coatings for the retention of fission products were studied. It was found that "molecularly deposited" ceramics such as alumina, siliconized silicon carbide, and pyrolytic carbon were excellent barriers to fission product leakage. The most advantageous location for ceramic coatings was found to be on the individual fuel particles, where the coating was subject to smaller forces and where a larger thickness-to-diameter ratio could be used than if the coating were on the surface of the graphite sphere. Fuel elements were irradiated to burnups ranging up to about 6 at.% U^{235}. In all specimens containing a uniform dispersion of fuel, the graphite spheres were found to retain their structural properties after irradiation. Data are given on fuel particle coatings of Al_2O_3, pyrolytic carbon, and metals; surface coatings of

siliconized silicon carbide, pyrolytic carbon, and metal carbides; properties of and the effects of irradiation on graphite spheres; the use of natural graphite in preparing a high-density matrix material; graphite fueling by thorium nitrate infiltration; subsurface metal and metal carbide coatings for graphite; and an in-pile loop program on the behavior of fission products in a recycle helium stream. (auth)

9664 (ORNL-3210) GAS-COOLED REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 30, 1961. (Oak Ridge National Lab., Tenn.). Feb. 5, 1962. Contract W-7405-eng-26. 264p.

Progress is reported on investigations in support of the Experimental Gas-Cooled Reactor, the Pebble-Bed Reactor Experiment, Advanced reactor design and development, test facilities, components, and materials. Topics covered include EGCR physics, EGCR performance analyses, structural investigations, EGCR component and materials development and testing, EGCR experimental facilities, PBRE physics and design studies, fueled-graphite investigations, clad fuel development, design studies of advanced power plants, experimental investigations of heat transfer and fluid flow, development of equipment and test facilities, and fabrication studies. (M.C.G.)

9665 (ORNL-3215) MOLTEN-SALT REACTOR PROGRAM PROGRESS REPORT FOR PERIOD FROM MARCH 1 TO AUGUST 31, 1961. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Jan. 19, 1962. 151p.

The Molten Salt Reactor Experiment design, component development, and engineering analysis is discussed. Materials studies for the Molten-Salt Reactor Program including metallurgy, in-pile tests, chemistry, engineering research, and fuel processing are described. (M.C.G.)

9666 (PRWRA-GNEC-4) BOILING NUCLEAR SUPERHEATER (BONUS) POWER STATION. Supplementary Study. Extrapolation to Large Central Station Integral Nuclear Superheat Plant. (General Nuclear Engineering Corp., Dunedin, Fla.). For Puerto Rico Water Resources Authority, San Juan. Contract AT(40-1)-2484, Subcontract NP-1. 36p.

An evaluation was made of the maximum size plant for which the BONUS reactor plant could serve as a realistic prototype and the design changes required to increase the size and characteristics for the present BONUS design such that it could serve as a realistic prototype for the largest feasible integral-superheat reactor power plant. (M.C.G.)

9667 (SRO-64) HEAVY WATER POWER REACTOR PROGRAM, MONTHLY PROGRESS REPORT, JANUARY 1962. (Savannah River Operations Office, AEC). 16p.

Design work and testing of the CANDU refueling machine are reported. Research and development work on nested tube fuel assemblies for the HWCTR are also reported along with the results of cost optimization studies. Information concerning the development status of the HWCTR is included along with similar information on the Parr Shoals Reactor. (J.R.D.)

9668 (TID-13028) MONTHLY OPERATING REPORT, MAY 1961 [ON PWR OPERATIONS]. (Duquesne Light Co., Shippingport, Penna.). Contract AT(11-1)-292. 70p.

Monthly activities are summarized covering operations, refueling, maintenance, testing and training programs, and construction. (B.O.G.)

9669 (TID-13436) MONTHLY OPERATING REPORT, JULY 1961 [ON PWR OPERATIONS]. (Duquesne Light Co., Shippingport, Penna.). Contract AT(11-1)-292. 58p.

Monthly activities are summarized covering operations, refueling, maintenance, testing and training programs, and construction. (B.O.G.)

9670 (TID-14629) MONTHLY OPERATING REPORT, NOVEMBER 1961. VOLUME IV, ISSUE 11. (Duquesne Light Co., Shippingport, Penna.). Contract AT(11-1)-292. 43p.

Power generation was resumed on November 2, 1961 after being shutdown 3 days for core physics testing. Two incidents, one involving linear power amplifiers and the other hydraulically operated butterfly valves, were caused by mechanical malfunctions. Water conditions were maintained within reference specifications. A burst of fission product iodine activity was noted during startup, confirming previous indications of the presence of at least one failed blanket assembly. The M-130 spent fuel shipping container was loaded and prepared for shipment. Radiation exposures to personnel were very low during the month. Four tests were performed. Construction and modification activities were confined to the Heat Dissipation System. (M.C.G.)

9671 (TID-14687) MONTHLY OPERATING REPORT, DECEMBER 1961. VOLUME IV, ISSUE 12. (Duquesne Light Co., Shippingport, Penna.). Contract AT(11-1)-292. 42p.

Power was generated without interruption maintaining an average output of 60 Mw net. Water conditions were maintained within reference specifications. There was no significant change in the average activity level of Cs^{138} in the reactor coolant at 100% power compared with November. The clarifier, clearwell, and sludge pit were drained for inspection. A maintenance program to determine the cause of a steady decrease in the sensitivity of the FEDAL system was placed in effect. The remaining 16 Seed 2 spent seed assemblies were loaded into the M-130 spent fuel shipping container and the container was shipped to the AEC Expended Core Facility in Idaho. Seven tests were performed. (M.C.G.)

9672 (TID-14879) DISSOLUTION OF FUEL ADDITIONS IN MOLTEN BISMUTH. Final Report, July 28, 1958–December 31, 1958. A. F. Weinberg and R. J. Van Thyne (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Feb. 13, 1959. For Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va. Subcontract AT(30-1)-1940-7. 51p.

U, Zr, and Mg must be dissolved in Bi to prepare initial fuel for the Liquid Metal Fuel Reactor Experiment and to adjust fuel concentration during operation. A program was conducted to determine which combinations of operative variables, shape and form of additive, and temperature of dissolution are required to satisfy the proposed reactor operating specifications so that dissolution should occur within: (1) 24 hours at 400°C for initial additions of Mg (1000 to 5000 ppm) and Zr (175 ppm); (2) 6 hours at 400°C for initial additions of U (1200 ppm); and (3) 15 minutes at 500°C for make-up additions of Mg (5000 ppm), Zr (100 ppm) and U (500 ppm). Dissolution of elemental U was found to be controlled by the rate of formation of an intermetallic compound requiring solid-state diffusion, and the required dissolution rates were not attained. Master alloys of Bi-10 wt % U provided sufficiently rapid dissolution rates for both initial and make-up additions. Elemental Zr (0.004 inch sheet) was suitable for initial additions, but Bi–Zr master alloys are required for satisfactory dissolution of make-up additions. Bi, as received from the smelter, was found to contain sufficient oxide to seriously affect dissolution and recovery of additives. (auth)

9673 (WAPD-MRP-95) PRESSURIZED WATER REACTOR (PWR) PROJECT TECHNICAL PROGRESS REPORT FOR THE PERIOD OCTOBER 24, 1961 TO DECEMBER 23, 1961. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Contract AT-11-1-GEN-14. 128p.

PWR Core 2. AEC approval was received of a revised seed cluster design which provides increased fuel plate stability. The design of the seed poison plates is being revised to incorporate 11% clearance volume for poison wafer growth. The control rod shroud stress and deflection test was completed. A conceptual design of the omega seal welding machine for PWR-2 reactor vessel penetration ports has been completed. The XITE-1 code has been used to evaluate end-of-life thermal performance with a consequent gain in core thermal capability. The MIM-1 code is being used to predict conditions past DNB, and loss-of-flow analysis has been extended into the natural convection period. Initial results from DNB tests on a section which simulates an actual blanket plate surface, with associated ribs and depressions, indicated no adverse effects on DNB because of the surface irregularities. Approximately 50% of the core complement of blanket fuel elements have been pressure bonded; all attributes continue in control. WAFD has been qualified through all blanket element post-bonding operations. Over 100 full-length elements have been processed up to the subassembly stage. The three blanket qualification subassemblies have been welded and are being evaluated; the third unit exhibited significantly better weld penetration and channel tolerance control. The seed Vendor Qualification fuel elements are being processed at WAFD; difficulty has been experienced with the ultrasonic resonance test equipment for detecting clad thinning. A dummy full length seed development cluster is being fabricated at WAFD utilizing electron beam welding. Bettis fabrication operations on approximately six million high density wafers and 400,000 low density wafers for four special clusters have been completed. Pyrolytic carbon coating of wafers at the vendor is proceeding satisfactorily, and completion of both types of wafers is expected in early February 1962. Fabrication operations on seed fuel wafers of a new size and composition as dictated by the redesign of the fuel element have been resumed. Previous grinding problems have been overcome with the use of diamond impregnated metallic bonded grinding wheels. Some problem exists in obtaining sufficient surface removal to obtain good carbon coating adherence without sacrificing uranium-235 loading control. An autoradiographic technique has been developed for the determination of the cladding thickness of blanket fuel plates with a precision of ±0.0005 in. of the 2 sigma level. An ultrasonic resonance technique has been developed for the determination of the cladding thickness of seed fuel plates with a precision of ±0.0006 at the 2 sigma level. All Inspection Development work on cladding thickness measurement has been completed. A gamma counting technique has been developed to nondestructively determine the U-235 loading of seed fuel powders with a precision of ±0.7% at the 2 sigma level. All Inspection Development work on fuel powder loading has been completed. A sensitive magnetic test has been developed for the determination of the amount of ferro-magnetic iron contamination present in fuel powders with a precision of ±3% at the 2 sigma level. All Inspection Development work on iron particle detection has been completed. PWR Core 2 Seed 2. It has been tentatively concluded that a 20,000 EFPH Seed 2 is feasible from thermal and mechanical viewpoints. PWR Core 1. Initial thermal data from Seed 3 operation have been evaluated. Evaluation of one blanket fuel rod at Bettis has been completed. The effect of an increased scram time on core thermal performance has been evaluated. Tools for removing irradiated fuel assemblies from the PWR-1 cartridge stored in the underwater core storage rack have been designed. A method has been investigated for representing a replaced seed in the TURBO-ZIP synthesis model used in the nuclear analysis of PWR-1. Substantially increased analytical complexity was found necessary to represent a partially refueled core. Measured blanket power fractions have been less thus far during Seed 3 operation than for comparable Seed 2 conditions, as expected because of reduced blanket reactivity during Seed 3 operation. Metallurgy of Core Materials. X-ray diffraction patterns obtained on UO_2 irradiated to 37.5×10^{20} fissions/cc in the M42 element of the X-1-p loop test showed sharp diffraction peaks with little or no change in unit cell size or line broadening. Reexamination of UO_2 irradiated to about 30×10^{20} fissions/cc in the I-21 element of the CR-V-m test showed that this material was also entirely crystalline. Metallurgical examination of the most highly depleted rod in the PWR-1 blanket after two seed lives showed no significant changes in dimensions and fuel or cladding microstructure. The fission gas release from the fuel and the hydrogen pick-up of the Zircaloy-2 sheath were consistent with previously obtained experimental data. Metallographic examination of defected compartments from beta-treated oxide fuel plates after short time corrosion test periods indicated that no sharp end point existed for the increase in excess weight gain. A test period of 7 days in 750°F steam was established by other considerations that included: (1) scatter in measured weight gains of normal Zircaloy, (2) the corrosion behavior of an internal surface, (3) the sensitivity to measure the excess weight gain, and (4) the sensitivity to measure the amount of fuel-clad reaction. Reactor Physics. Monte Carlo calculations have been completed which match the observed power peaking in the edge fuel region adjacent to the control rod channel. Calculations of the stable fission product poison cross section for PWR-2 Seed 1 and blanket have been completed. These include the effect of radioactive decay and a comparison is made of the effect of neglecting this decay. An investigation has been completed comparing the results of single energy and multigroup thermal neutron energy calculations of detector disadvantage factors. The results indicate that the two techniques yield the same results so that use of the more sophisticated technique will not alter the results of seed power distribution measurements which have been reported previously. The experiments for U-235 fission-product poisoning give tentative results for the 2200 m/sec cross section of 44 ± 25 barns per fission and a resonance integral from 0.625 ev to infinity of 230 ± 150 barns per fission. Plant Modification for PWR-2. Approval of the document defining the PWR-2 Inspection and Test Program was received. The AEC approved the design of the PWR-2 Safety Injection System which incorporates a booster pump to deliver flow through the FEDAL System. Approval of the multiple-ring stator can backup sleeve design for the PWR-2 main coolant pumps was withheld by the AEC pending demonstration of design adequacy in the lead pump. The AEC approved the development program for a reactor plant loop filter. The detailed design drawings and Inconel cladding procedures for the PWR-2 Foster-Wheeler steam generators were approved. A redesign of the main coolant pump to extend the maximum flow limit was recommended. The design of the temporary radiation shielding for the PWR-2 Babcock and Wilcox steam generators was approved by the AEC. The water level gage material was specified

as Inconel by the AEC. The PWR-2 Rod Control System and specifications were approved by the AEC and procurement is proceeding. Note: It was erroneously reported in WAPD-MRP-94 that a neutron source was utilized during the PWR-1 Seed 3 refueling. Although provision for a source was made, it was not used. (auth)

9674 (WAPD-T-1429) SHIPPINGPORT ATOMIC POWER STATION OPERATING EXPERIENCE, DEVELOPMENTS, AND FUTURE PLANS. Prepared for the U. S.–Japan Atomic Industrial Forum, Tokyo, Japan, December 5-8, 1961. P. A. Fleger (Duquesne Light Co. Shippingport, Penna.), I. H. Mandil (Division of Reactor Development, AEC), and Philip N. Ross (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Contract [AT-11-1-GEN-14]. 79p.

The experience obtained during four years of operation and testing of the Shippingport Atomic Power Station is described and evaluated. The current technical developments and future plans are discussed. Station operating experience and project history are outlined. Core loading, total electricity generated, and fuel burnup data are presented. Forty-two figures and pictures are included. (M.C.G.)

9675 (WCAP-1391(Rev.)) MULTI-LAYER CONSTRUCTION FOR THE SAXTON REACTOR VESSEL. L. R. Katz (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Feb. 1, 1960. 31p.

A review is presented of the engineering analysis, fabrication methods, and quality control techniques used in the manufacture of the multi-layer pressure vessel of the Saxton Power Reactor. The safety and reliability aspects of the use of this type of vessel in the Saxton reactor are studied. (T.F.H.)

9676 (WCAP-1620) SUPPLEMENTARY TECHNICAL INFORMATION ON THE SAXTON REACTOR VESSEL. L. R. Katz (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Aug. 17, 1960. 33p.

A study is made of the safety and reliability of the multilayer pressure vessel of the Saxton Power Reactor. The study comprises a review of the operations histories of similar vessels; a summary of the quality control methods used in the reactor vessel's manufacture; and a description of the service stresses expected to be placed on the vessel in reactor use. On the basis of the study, operating limitations are proposed for the reactor. (T.F.H.)

9677 (WCAP-4062) CVTR PROJECT, CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC. MONTHLY PROGRESS REPORT, DECEMBER 1961. (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Contract AT(30-1)-2289. 21p.

Activities concerning the nuclear design, pressure-tube assembly and analysis, irradiation experiments and analysis, materials development and fabrication techniques, development of fuels, components, and plant systems, instrumentation and control, safety analysis, critical experiments, and pre- and post-construction research and development on the Carolinas-Virginia Tube Reactor are summarized. (T.F.H.)

9678 (XDC-55-11-101) AN OPERATIONAL AND MAINTENANCE GUIDE FOR THE HTRE NO. 1 SERVO SYSTEM. H. S. Starling and R. I. Emmert (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 21, 1955. Contract [AT(11-1)-171]. 37p.

The guide is presented in four major sections including an introduction, a section on the function of the servo loops and shim circuit, a section containing a description of the components and gain and balance adjustments, and a check-out procedure section. (auth)

9679 (AEC-tr-4678) CALCULATION OF THE THERMAL UTILIZATION FACTOR (A REVIEW). A translation of "O Vychislenii Koeffitsienta Teplovogo Izpol'zovaniya." A. D. Galanin (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 26p.

An account is given of a method of calculating the lumping effect in thermal neutrons, suggested by Amouyal, Benoist, and Horowitz. This method is based on the assumption that neutrons from the moderator entering a lump of uranium are distributed isotropically according to angle. Simple formulas are presented for the internal and external lumping effect, and also for the magnitude of the jump in neutron density in the annular gap around the lump. The results obtained are compared with other methods of calculation, including numerical solution of the one-velocity Boltzmann equation, and also with experimental data. This comparison shows that the method considered has very high accuracy. More accurate expressions were derived which are beyond the limits of the one-velocity approximation. (auth)

9680 (AEC-tr-4945) THE USE OF SUPERCRITICAL STEAM IN PRESSURIZED POWER REACTORS. S. A. Skvortsov and S. M. Feinberg. Translation of "O Primenenii Sverkhkriticheskikh Parametrov Para v Vodovodyanykh Energeticheskikh Reaktorakh." Paper No. 31 of Symposium on Power Reactor Experiments held at Vienna, October 23-27, 1961. 17p.

The theoretical considerations in the possibility of using supercritical steam in nuclear reactors are presented. One of the possible variants in the construction of a reactor unit with associated equipment, which will attain an electrical power of 1000 to 1400 megawatts, is also considered. (auth)

9681 PLANNING AND CONSTRUCTION OF THE EXPERIMENTAL NUCLEAR POWER PLANT IN KAHL. K. H. Knobling and K. Roos (Bautechnische Büro der AEG, Frankfurt am Main). Atompraxis, 8: 12-19(Jan. 1962). (In German)

Discussion is given on planning problems which arise in the construction of nuclear power plants and auxiliary facilities. Certain basic concepts in regard to such projects are discussed. The experimental nuclear power plant in Kahl will initially have a relatively small net electric output of 15000 kw. It is intended to provide information on the construction and operation of atomic power plants. The Kahl reactor operates on the boiling-water principle, the heat produced in the nuclear fuel is carried off by the vaporization of the water, which serves as both moderator and coolant. The turbine is driven by secondary steam produced in an intermediate heat exchanger. The reactor with the primary cycle is contained in a steel shell. Storage facilities for radioactive refuse and exhausted fuel elements are housed in a separate building. The steam turbo-unit, switching facilities, maintenance equipment, workshops, laboratories, and administrative offices are also in separate buildings. (auth)

9682 THE CONTROL OF NUCLEAR POWER STATIONS. B. H. Stonehouse and A. J. Spurgin (United Power Co., Ltd., [Eng.]). Elec. Rev., 169: 945-9(Dec. 15, 1961).

The design of the control system of a power station must take into account the characteristics of the electrical network into which the output will be fed and the load de-

mands on the station. With these characteristics in mind, the control of nuclear power stations feeding into the British grid is considered. The ultimate choice of the scheme to be employed is an economic one. The cost of the equipment has to be balanced against the economic value of maintaining system frequency stability and of reducing the amount of manual control required from the reactor operator. To these factors has to be added the possible cost of replacing the fuel elements in the channels adjacent to the sector control rods. The final choice of the scheme to be employed will vary with the characteristics of the supply network and the experience gained in the nuclear power stations currently under consideration. Several methods and systems for controlling the stations are briefly outlined and described. (N.W.R.)

9683 HTGR TO HAVE CARBON-STEEL VESSEL. Completion of Peach Bottom estimated for March 1964, Steam conditions of 40-Mw unit to be 1,450 psi, 1,000 F. G. H. Bosworth (Bechtel Corp., San Francisco), and Corwin Rickard. Elec. World, 156: No. 23, 75-8(Dec. 4, 1961).

The Peach Bottom Atomic Power Station, now being designed, is described. The 40 Mw plant will incorporate an advanced, compact, graphite-moderated, helium-cooled reactor, designed to use graphite-clad fuel-moderator elements. The completion data are set for March 1964. Steam conditions will be 1450 psi and 1000°F. Some of the development work being done is described along with the proposed development programs. Operating conditions and reactor parameters are presented along with the electrical generating features. (N.W.R.)

9684 SOVIET NUCLEAR POWER PLANT WITH BWGR TYPE GRAPHITE REACTOR AND HIGH PRESSURE STEAM SUPERHEATER. Władyslaw Ney. Energetyka, 15: No. 1, 23-7(1961).

A description is given of a boiling water graphite reactor with steam superheating in the core. Experience gathered from operation of the Obinsk power plant since June 1954 contributed decisively to the construction of a 200 Mw nuclear power plant in Belouralsk, which is scheduled to become operative in 1961. The plant has two improved reactors of the light water graphite moderated, heterogeneous type. Data on the reactors include: thermal power 285 Mw, electrical power 100 Mw, average fuel life 730 days, fuel charge 90 tons, initial uranium enrichment 1.3%, shut-down enrichment 1.03%, average burn-up of U^{235} 2.7 kg/t, and average thermal fuel utilization 2300 Mwd/t. (P.C.H.)

9685 NUCLEAR POWER PLANTS– NUCLEAR REACTORS. A. Schneider. Energie, 13: 356-63(Aug. 1961). (In German)

A survey of nuclear power plants in operation and under construction, especially the reactors, is given and the trends of development are shown. Only nuclear power plants with 5 Mw(e) or more, which serve solely or predominantly for the production of electric power, were considered. Those in the design stage are indicated only insofar as they are directly related to plants under construction. (tr-auth)

9686 THERMAL OPTIMIZATION OF REACTOR PLANTS. PART II. CONDITIONS FOR OPTIMAL TEMPERATURES AND THROUGHPUTS IN PRIMARY COOLING LOOPS AND SECONDARY-SIDED SATURATED STEAM PROCESSES ACCORDING TO THE EXAMPLE OF A PRESSURIZED WATER SYSTEM. J. Krebs and L. Gabriel. Energietechnik, 11: 396-400(Sept. 1961). (In German)

Previous publications neglected heat transfer conditions in the steam generator in thermal optimization of reactor plants. It is shown in what strong measure assumptions of this kind influence the results. It is further indicated that through a thermal optimization calculation the range for the most suitable interpretation can be ascertained by certain hypothesis. A generally applicable optimal interpretation is still not given. The economic advantages of an optimal thermal interpretation of a reactor plant are discussed. In reactor development for the industrial production of energy by reactors, the possibility of thermal interpretations and cost lowerings will be utilized. (tr-auth)

9687 MAINTENANCE EXPERIENCE OF THE CALDER REACTORS. Engineer, 212: 1088-91(Dec. 29, 1961).

Calder experience extending over fourteen years of reactor operation has shown that under proper surveillance, major engineering modifications and the survey and maintenance of the plant can be undertaken in safety by essentially standard engineering techniques and with plant availability factors comparable with those attained on conventional plants. The maintenance programs, work programs, and reactor test schedules, co-ordinated with refuelling operations, are discussed. The maintenance program is briefly described for the reactor pressure vessel, heat exchangers, ducting, main circuit isolating valves, gas circulators, heat exchanger circuits, gas circulator drives, control rod actuating mechanisms, charge and discharge equipment, and turbine hall plant. Methods for testing the equipment are accounted for along with the practices used for safety conditions. (N.W.R.)

9688 SUPERHEATED STEAM AT INDIAN POINT. E. C. Koch. Heat. Eng., 36: 55-9(July-Aug. 1961).

The superheaters of the Indian Point nuclear-electric generating station are described along with associated equipment. The two separately oil-fired radiant-convection type superheaters will superheat saturated 450°F steam from the reactor to 1000°F to increase the output of 163 Mw from the reactor to a total gross plant output of 275 Mw. This feature of the nation's first nuclear-powered steam-electric generating station to utilize separately-fired superheated steam aids the plant in reducing the costs to develop economical electrical generation from nuclear power. Some of the design features of the plant are described with regards to electric generating equipment. (N.W.R.)

9689 PACKAGED NUCLEAR REACTORS. C. H. Fox (Martin Co., [Baltimore]). New Scientist, 12: 611-15(Dec. 7, 1961).

The features of the Army Reactor(PM-1) at Sundance, Wyoming for supplying power to a radar station and the Army Reactor(PM-3A) at McMurdo Sound, Antarctica for supplying electric power are described. The PM-1 has a power level of 1 Mw and the PM-3A has a power level of 1.5 Mw. Particular emphasis is placed on transportation limits, cost of transportation, power level, allowable installation time, health physics, design life, applications, and fuel enrichment. (N.W.R.)

9690 CONCEPT OF THE SEMI-HOMOGENEOUS REACTOR (SHR) AND PRESENT STATUS OF RESEARCH IN JAPAN. S. Yajima (Japan Atomic Energy Research Inst., Tokyo). Review Series No. 19 of "Developments in the Peaceful Applications of Nuclear Energy" of the International Atomic Energy Agency, Vienna. Dec. 1961. 34p. (STI/PUB/15/19). $1.00(IAEA).

The basic concept and development of the Semi-Homogeneous Reactor (SHR) are described. Development of the SHR stems primarily from a chemical concept; therefore

emphasis is placed on the chemical aspects, with detailed discussion on the trapping and behavior of fission products in recoil media, the preparation of solid homogeneous fuels, the properties of reactor materials, and the chemical reprocessing of solid homogeneous fuels. Chemical research required for the SHR development is also discussed. In addition a brief description is given of the critical assembly of the SHR and other engineering installations. (auth)

Production Reactors

9691 (NP-11343) THERMISCHES BRUTEN. LITERATURUBERSICHT UBER REAKTOREN UND DATA (STAND VON HERBST 1961). (Thermal Breeders. Literature Search on Reactors and Data, Autumn 1961). Oskar Liskowsky, comp. (Kernforschungsanlage, Jülich, Germany). Sept. 28, 1961. 11p. (Dok/Lit-Inf.-40)

A bibliography of 67 references is presented on thermal breeder reactors. (D.L.C.)

Research Reactors

9692 (AERE-M-846) SHIELDING CALCULATIONS AND DOSE-RATE PREDICTIONS FOR DAPHNE REACTOR. G. Constantine and K. R. E. Smith (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1961. 21p.

An analysis is made of the dose rates to be expected outside the shield of the reactor DAPHNE at a power of 100 watts and inside the shield when the reactor is shut down. It is shown that the dose rate outside the radial shield should not exceed 6 mr/hr. The dose rate above the top shield (the weakest point) is unlikely to exceed 28 mr/hr. However, if the core is loaded throughout with Mark III fuel elements containing empty thimbles and no plugs, the dose rate might approach 90 mr/hr. The activities of the fuel elements and control arms are examined and dose rates calculated outside fuel element flasks of various thicknesses of lead. (auth)

9693 (CNEN-100) EXPERIMENTS AND CALCULATIONS ON A D_2O 20% ENRICHED REACTOR. M. Bernardini, A. Bracci, U. Farinelli, P. Loizzo, M. Motta, and C. Tamagnini (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Nov. 1961. 79p.

The results of several critical experiments performed on the Ispra I reactor are discussed and compared with calculations. Two-group theory is shown to yield accurate results in most cases. The relevance of the various effects, in experiment and calculation, is analyzed. (auth)

9694 (CRIO-1043) A GENERAL DESCRIPTION OF THE NRX REACTOR. E. A. G. Larson (Atomic Energy of Canada Ltd., Chalk River, Ont.). July 1961. 90p. (AECL-1377)

The NRX reactor structure, equipment, and experimental facilities are described. The information gives only a general knowledge of the reactor and is to serve as an introduction to the NRX Design and Operating Manuals. (D.L.C.)

9695 (DC-58-6-229) NUCLEAR TEST GAUGE SAFETY SYSTEM. G. K. Rusch and W. E. Sabin (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 27, 1958. Contract AT(11-1)-171. 47p.

The transistorized safety system for the Nuclear Test Gauge (NTG) is described. NTG refers to a subcritical reactor used to detect variations in the nuclear properties of various test specimens. (J.R.D.)

9696 (IDO-16733) MATERIALS TESTING REACTOR-ENGINEERING TEST REACTOR TECHNICAL BRANCHES QUARTERLY REPORT, JULY 1–SEPTEMBER 30, 1961. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Dec. 1, 1961. Contract AT(10-1)-205. 44p.

Experiments were continued in connection with establishing design parameters of a chemical control system proposed to replace solid regulating rods in the ATR. Measurement of the rate of radiolytic decomposition of concentrated water solutions of boric acid in a thermal neutron field was made by means of capsule experiments. A 20-gram/liter natural H_3BO_3 solution exposed to a thermal neutron flux of 1.4×10^{14} nv yielded hydrogen at the rate of 1.28 liter of H_2 (STP)/liter of solution per 1×10^{16} nvt of exposure. The oxygen production was close to $\frac{1}{2}$ of this value. Fuel element development studies indicated that irradiation-induced "damage" zones found around UO_2 particles in an aluminum-matrix fuel plate appear to have some correlation with fuel particle size and gas bubble formation. Burnup determination on the UO_2–SS system for the EGCR offers a wide range of values depending upon the method of analysis. Capsule temperatures as a measure of heat generation are useful for estimates of burnup providing suitable standardization is made previously with radiochemical analysis of Co^{60}, Cs^{137}, and Ce^{144}. Experimental measurements of Pu^{241} fission cross sections and Pu^{238} total cross sections are underway in the fast chopper. Studies of gas content of irradiated beryllium are being continued with samples now available from a new irradiation series. A new $4\pi\beta$-γ coincidence counting system is nearly routinely operational and a new silicon surface barrier α spectrometer is essentially complete. Measurements of the inelastic scattering of neutrons from sodium and high pressure methane are underway using the neutron phased chopper velocity selector, and a new Be filter has been installed for the cold neutron facility. The experimental measurements on the dispersion relations of single beryllium crystals are complete and theoretical models to provide fits are being tested. An investigation of the gamma radiation following the decay of 2.6-hr Ni^{65} was conducted. Four previously unreported gamma rays were found. A directional correlation of one of the gamma-ray cascades provided a unique spin assignment for the 1480-kev state in Cu^{65}. Development work on the semiconductor charged-particle detectors is continuing. Typical Am^{241} and Pu–alpha spectra obtained with these detectors are presented. The minimization of variances of directional correlation coefficients was considered. Preliminary calculations indicated that significant reduction of the experimental variances of these coefficients can be obtained by a proper choice of angles and relative measurement frequency. An all-electronic scanning switch was designed to allow the scanning of 100 separate decimal digits. The switch is used in this instance to scan both manual switch and glow transfer tube decimal positions with readout to typewriter and IBM punch cards. Two programs were prepared for the EOCR studies: reactor kinetics code to study control requirements, and a program to determine the coolant flow in each element and the total reactor flow requirement. Several Monte Carlo programs are being written to evaluate theoretical differential cross sections for use in other calculations. Since pulse height spectra for monoenergetic gamma rays can be determined experimentally for only a restricted number of discrete

energies, a program was written for the IBM 650 which uses experimentally-determined curves as reference points and allows interpolation of the wider range of energies required. (auth)

9697 (MSAR-62-05) AN EXPERIMENTAL STUDY OF THE DYNAMIC RESPONSE CHARACTERISTICS OF THE NPD-2 VAPOR RELIEF SYSTEM. Final Report. V. K. Heckel, G. E. Kennedy, and E. C. King (Mine Safety Appliances Research Corp., Callery, Penna.). Jan. 25, 1962. Contract [AT(38-1)-229]. 44p.

In the event of a catastrophic leak in the Atomic Energy of Canada Limited (AECL)NPD-2 boiler room the pressure will rise rapidly. Calculations indicate that this pressure rise will not exceed 5 psi, which is the maximum design pressure of the building. In order to confirm these calculations a $\frac{1}{4}$ scale model of the boiler room and relief duct were made. The relief duct was sealed with $\frac{1}{4}$ inch thick herculite glass with an explosive attached to it which was fired by means of electrical circuit through a microswitch actuated by the pressure rise. When these microswitches were set to close at 1.2 psi the pressure rise did not exceed the design limit of 5 psi. (auth)

9698 (NDA-84-16(Vols. I & II)) 10 MWe SODIUM DEUTERIUM REACTOR DESIGN REPORT. Peter J. Davis (Nuclear Development Corp. of America, White Plains, N. Y.). Feb. 28, 1959 (Vol. I). Mar. 31, 1959 (Vol. II). Contract AT(30-3)-256. 358p.

The preliminary design is presented for a 10-Mw(e) Sodium Deuterium Reactor (SDR) and its associated systems and facilities. The Calandria, fuel-coolant tubes, barrier tubes, fuel elements, control rods, shielding, and pilot features are described. The following systems are discussed: sodium, D_2O, nitrogen, organic, reactor control, refueling, and waste disposal. The site, containment buildings, and process and administration buildings are described. The inherent safety features, design safety features, safety analysis, and contained accident study are discussed. (M.C.G.)

9699 (NP-11272) PETROLITE IRRADIATION REACTOR, HAZARDS SUMMARY REPORT. (Petrolite Corp., Webster Groves, Mo. and Internuclear Co., Inc., Clayton, Mo.). Dec. 1961. 108p.

The Petrolite Irradiation Reactor, a proposed high-flux (flux trap), low-power reactor for neutron activation analysis, isotope production, and nuclear research, is described and a hazards report given. Site characteristics and a proposed plan of reactor operation and administration are included. (D.L.C.)

9700 (NP-11333) HAZARDS SUMMARY REPORT FOR THE PURDUE UNIVERSITY REACTOR I. (Purdue Univ., Lafayette, Ind. Engineering Experiment Station and Lockheed Nuclear Products, Marietta, Ga.). Jan. 15, 1962. 177p.

The installation, use, operation, and physical description of the 10-kw pool-type Purdue University Reactor I are discussed. Attention is devoted to proposed experiments, to the various reactor operating modes, and to the hazards involved in normal and abnormal reactor operation. Other aspects discussed include the site and building, nuclear accidents, radioactive effluents, construction schedule, finances, and changes in core reactivity. (T.F.H.)

9701 (ORNL-TM-10) ORR OPERATIONS FOR PERIOD APRIL 1960–APRIL 1961. J. A. Cox (Oak Ridge National Lab., Tenn.). Oct. 20, 1961. Contract [W-7405-Eng-26]. 106p.

Conversion of the ORR from 20 to 30 Mw operating level was achieved during July 1960 after a scheduled shutdown for completion of a new cooling system. Operating time reached a high of 82% during the last quarter of 1960. The first quarter of 1961 showed an operating time of 80% despite 2 shutdowns and some additional down time to repair mechanisms associated with the shim rods. Changes were made in the south engineering test facility for GCR test loops. Detailed data taken from quarterly operational reports are included. (J.R.D.)

9702 (AEC-tr-4550) GENERAL FEATURES OF THE PROJECT RAPSODIE. Excerpt from a Report of the Commissariat a l'Énergie Atomique, France. A translation of "Vue d'ensemble sur le Projet Rapsodie." [June 1960]. 27p.

The present status of the design of the RAPSODIE reactor, a fast sodium-colled pile for studies of this pile type, is outlined. The topics discussed include: core, cover, reflector, tank, upper seal, thermal circuits, control, and site. (D.L.C.)

9703 (CEA-tr-A-1026) FLUX DE NEUTRONS RAPIDES DANS QUELQUES POSITIONS D'IRRADIATION DU F.R.M. (Fast Neutron Flux in Some Irradiation Positions of the F.R.M.). W. Koehler ([Munich. Technische Hochschule]). Translated into French from German Report FRM-30. Dec. 1960. 31p. (Includes original, 17p.).

The fast neutron flux is measured in three special elements of the 4 × 6-element array of the FRM pool-type reactor in Munich. The flux measurements are made using the threshold reactions $P^{31}(n,p)$, $S^{32}(n,p)$, $Ni^{58}(n,p)$, and $Al^{27}(n,\alpha)$. The total fast neutron flux (above 0.1 Mev) is thus measured, with the aid of the calculated spectral distribution. At the center of the core, this flux is found to be 1.2×10^{13} neutron-cm^{-2}-sec^{-1}-Mw^{-1}. (tr-auth)

9704 LOW-TEMPERATURE IRRADIATIONS IN A REACTOR BEAM PORT. Marvin D. Silbert and Richard H. Tomlinson (McMaster Univ., Hamilton, Ont.). Nucleonics, 20: No. 2, 73(Feb. 1962).

A description is given of the beam hole of the 1 Mw McMaster University pool-type reactor and the method used in accomplishing low-temperature reactor irradiations. The reactor irradiations are made in order to study temperature and phase effects on chemical behavior of atoms formed by neutron capture. The beam tube has internal and external shields. The $2\frac{1}{4}$-in. OD tube is in two sections joined by a collar at the pool-wall outer face; the outer section can be removed and replaced by a plug when it is not used. The method for inserting and removing the Dewar irradiation flask is described. (N.W.R.)

9705 SLURREX. BOILING SLURRY REACTOR EXPERIMENT. George A. Freund and Joseph D. Lokay (Argonne National Lab., Ill.). Nucleonics, 20: No. 2, 74-5(Feb. 1962).

SLURREX, a BORAX-type aqueous-boiling-slurry-reactor experiment, is the combination of natural-circulation boiling with the water-slurry-homogeneous reactor concept. The design parameters and flow diagram for the reactor are presented. The performance and operation of such a reactor is also described. The advantages and problems of such a reactor are discussed. (N.W.R.)

SPACE APPLICATIONS AND TECHNOLOGY

9706 (AFBSD-TR-61-58) THE APPLICATION OF MAGNETOHYDRODYNAMIC GENERATORS IN NUCLEAR ROCKET PROPULSION. Research Report 111. R. J. Rosa (Avco Corp. Avco-Everett Research Lab., Everett, Mass.). Aug. 1961. Contract AF04(647)-278. 48p.

Several nuclear propulsion schemes using a magnetohydrodynamic (MHD) generator are considered, including in particular closed power cycles that use the propellant as their heat sink. The use of the air stream for thrust augmentation is also considered, for cases in which an ambient atmosphere exists. With electric power as the fuel an air breathing engine can, in principle, have high efficiency over a wide velocity range. Such a powerplant, in addition to avoiding the problem of retaining fissionable material, would have a great advantage in specific impulse and load carrying ability over a gas core reactor used alone. (auth)

9707 (AFCRL-281) TESTS OF A CESIUM THERMIONIC CONVERTER DESIGNED TO UTILIZE SOLAR ENERGY IN OUTER SPACE. Scientific Report No. 3. V. C. Wilson and Jackson Lawrence (General Electric Co. Research Lab., Schenectady, N. Y.). Aug. 1960. Contract AF19(604)-5472. 24p. (AD-260359)

A cesium thermionic converter with an integral radiator for solar application was designed and tested. Design, construction, and processing techniques are discussed. Performance data under various operating conditions are given including maximum output power at 1800°C of 85 watts with 15% efficiency. The electric generator and reject heat radiator weighs 7.5 lbs per kilowatt of output electricity. (auth)

9708 (AFOSR-1830) FOCUSING OF A CESIUM PLASMA BY THE APPLICATION OF AN RF FIELD GRADIENT. L. S. Napoli (Radio Corp. of America. RCA Labs. Div., Princeton, N. J.). Oct. 31, 1961. Contract AF49(638)-658. 26p.

A synthesized cesium plasma was focused by the application of quadrupolar electric fields at frequencies of 141, 395, and 1000 mc. The force was found to decrease with increasing frequency and to increase with increasing applied electric fields. However, the force did not depend on the particle density. These results are in qualitative agreement with theory. (auth)

9709 (JPL-TR-32-158) SYSTEMS ENGINEERING OF A NUCLEAR-ELECTRIC SPACECRAFT. Robert J. Beale (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Oct. 31, 1961. Contract NASw-6. 17p.

Typical designs under consideration for interplanetary missions for the next decade employ a nuclear reactor providing thermal energy to a turbogeneration system, which in turn supplies electrical power to an ion engine for primary propulsion and additional utility power for guidance and control, powered-flight radio transmission, instrumentation, et cetera. The major systems and components that form a complete spacecraft are listed, and a review of the significant physical and operational characteristics of the various systems and components that affect spacecraft integration is made. Conceptual configurations and detailed weight studies for a 60-kwe Venus-capture spacecraft and a 1-Mwe Jupiter-capture spacecraft are shown to illustrate typical physical arrangements based on the various hardware constraints. From these configurations, the major development goals are ascertained and summarized. (auth)

9710 (JPL-TR-32-159) PERFORMANCE OF NUCLEAR-ELECTRIC PROPULSION SYSTEMS IN SPACE EXPLORATION. Evelyn W. Speiser (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Dec. 15, 1961. Contract NASw-6. 20p.

An analysis is presented of the payload capabilities of nuclear-electric spacecraft for interplanetary exploration. Results are presented in terms of vehicle terminal mass at its destination as a function of flight time for the mission. The missions which were studied include probes and orbiters to most of the planets in the solar system, plus solar probes and flights out of the plane of the ecliptic. For a given mission, flight time is chiefly determined by the initial acceleration of the spacecraft, whereas terminal mass is chiefly determined by the specific impulse of the thrust device. Some generalized curves are presented which indicate the initial accelerations required for several missions. The specific impulses required for various ratios of terminal mass to initial mass are shown for the same missions. Once a particular set of mission flight time and payload requirements is established, the optimum combination of ion engine characteristics, power plant weight and power level, and launch vehicle can be specified to satisfy these requirements. (auth)

9711 (LMSD-288084) SATELLITE INSTRUMENTATION FOR MEASURING SPACE NUCLEAR RADIATION. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Nov. 1959. Contract AF04(647)-347. 117p.

The equipment carried by the Discoverer satellite for measuring space radiation is described. Anticipated space radiation fields are discussed. Design and construction of active (telemetering) and passive payload components are considered in detail. (D.L.C.)

9712 (NASA-TN-D-474) DETERMINATION OF NUCLEAR-ROCKET POWER LEVELS FOR UNMANNED MARS VEHICLES STARTING FROM ORBIT ABOUT EARTH. Richard H. Cavicchi and James W. Miser (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Jan. 1962. 41p.

Nuclear-powered earth-orbital-launch probes can place greater payloads in orbit about Mars than chemical vehicles if reactor power exceeds 50 Mw. Suitable reactor powers for this mission are about 150, 400, and 1000 Mw for 33,000-, 81,000-, and 200,000-lb vehicles, respectively. Whereas a 33,000-lb vehicle requires greater than a 200-day coast, a 145-day coast is feasible for an 81,000-lb vehicle. A hydrogen temperature of 4000°F in the nozzle appears to be a good compromise. Use of a solid-propellant rocket to achieve an orbit about Mars from coast yields no payload advantage. Using optimum firing dates, a 33,000-lb vehicle could orbit an acceptable payload about Mars, and an 81,000-lb vehicle could land freight on Mars. (auth)

9713 (NASA-TN-D-587) ANALYSIS OF LIQUID-HYDROGEN STORAGE PROBLEMS FOR UNMANNED NUCLEAR-POWERED MARS VEHICLES. R. J. Brun, J. N. B. Livingood, E. G. Rosenberg, and D. W. Drier (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Jan. 1962. 67p.

Hydrogen storage tank geometry, weights of tank and supporting structures, meteoroid protection at a confidence level greater than 90%, size and weight of the nuclear shield, and heat inputs to the hydrogen from nuclear, solar, planetary, and on-board sources are discussed. Vehicles

with power levels of 25, 150, and 400 Mw, and respective gross loads of 33,000, 33,000, and 81,000 lb are considered. The vehicle is assumed to be initially in a circular earth orbit at an altitude of 300 nautical miles. (T.F.H.)

9714 (NASA-TN-D-878) ANALYSIS, FEASIBILITY, AND WALL-TEMPERATURE DISTRIBUTION OF A RADIATION-COOLED NUCLEAR-ROCKET NOZZLE. William H. Robbins and Carroll A. Todd (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Jan. 1962. 29p.

An analysis was made to determine the feasibility of operating radiation-cooled rocket nozzles with hydrogen as the propellant. Wall-temperature distributions and heat fluxes along the nozzle were calculated and presented over a range of chamber pressure and wall emissivity. Development of radiation-cooled nozzles may prove to be difficult because of high nozzle wall-temperature levels, but it appears to be desirable because of the potential performance gains in terms of specific impulse associated with these nozzles over regeneratively cooled nozzles and the anticipated difficulty of regenerative cooling at high chamber pressures. (auth)

9715 (NASA-TN-D-1004) THE DESIGN AND OPERATION OF A CONTINUOUS-FLOW ELECTRODELESS PLASMA ACCELERATOR. R. L. Barger, J. D. Brooks, and W. D. Beasley (National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.). Feb. 1962. 15p.

A continuous-flow induction plasma accelerator utilizing argon, or argon seeded with mercury vapor, was built and operated. Comparison of this alternating-current system with a previous investigation of a direct-current accelerator indicated that the induction system is more effective at pressures below 1 mm Hg. Vane-deflection measurements indicated that there was an effective pumping action on the neutral gas. (auth)

9716 (NASA-TN-D-1110) A PARAMETRIC STUDY OF THE THERMIONIC DIODE SYSTEM FOR LARGE NUCLEAR-ELECTRIC POWERPLANTS IN SPACE VEHICLES. Daniel T. Bernatowicz (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Jan. 1962. 53p.

The potential performance of thermionic diodes converting reactor heat to electricity for propulsion of space vehicles is explored. Electron heating, thermal radiation, joulean heating, and heat conduction losses are included; losses in the plasma are not. The diode system is compared with the Rankine cycle system using radiator area per unit of output power as the criterion. The diode system can surpass the turbogenerator if the diodes can be incorporated into the reactor fuel elements, electrodes with optimum work functions can be developed, and the anodes can be cooled by conduction without electrical short circuiting. (auth)

9717 (NASA-TN-D-1163) INVESTIGATION OF A 10-CENTIMETER-DIAMETER ELECTRON-BOMBARDMENT ION ROCKET. Paul D. Reader (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Jan. 1962. 38p.

A 10-centimeter-diameter electron-bombardment ion rocket capable of operation in performance regimes above 10 millipounds of thrust is studied. The source can operate above 10 millipounds of thrust continuously for 10 hours at a specific impulse of 6500 seconds. The engine can also operate for 150 hours at 4 millipounds of thrust. The source can produce 0.5-ampere beam currents at as low an impulse as 5900 seconds, yielding a calculated thrust of 13 millipounds. Accelerator impingement currents are on the order of 1 percent of the beam current. Mercury is used as a propellant in this investigation. (auth)

9718 (NP-11161) OBSERVATIONS OF THE VAN ALLEN RADIATION REGIONS DURING AUGUST AND SEPTEMBER 1959. PART II. THE CAPETOWN ANOMALY AND THE SHAPE OF THE OUTER BELT. Robert A. Hoffman. J. Geophys. Research, 66: 4003-6(1961). PART III. ELECTRON SPECTRA AND FLUXES IN THE OUTER ZONE. R. L. Arnoldy, R[obert] A. Hoffman, and J. R. Winckler. PART IV. THE INNER BELT. R[obert] A. Hoffman, R. L. Arnoldy, and J. R. Winckler (Minnesota. Univ., Minneapolis. School of Physics). Nov. 1961. Contract NASw-56. 90p. (CR-46)

From Aug. 7 to 13, 1959, the Explorer VI earth satellite passed twice a day through the heart of the outer Van Allen radiation region at latitudes near the magnetic equator. Part II presents evidence that any particles affected by the Capetown magnetic anomaly do not have trajectories which would pass through the position of the experimentally observed minimum in the outer belt. It is concluded that the minimum cannot be taken as evidence either for the effect of the anomaly on the trapped radiation, or for support of the neutron albedo source for the outer zone electrons. Part III describes the radiation detectors aboard Explorer VI, and presents information on the energy spectra and fluxes of the trapped electrons along a typical pass through the outer Van Allen radiation region. The findings are based on analysis of data from electron calibrations of the radiation detectors. Part IV presents data on the differential energy spectrum of an assumed power law form for trapped protons in the inner belt as determined from data received from the ion chamber and Geiger counter aboard Explorer VI earth satellite. (C.H.)

9719 (NP-11321) ASTRONAUTICS INFORMATION. OPEN LITERATURE SURVEY, VOL. IV, NO. 6, (ENTRIES 41,269–41,476). (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Dec. 1961. Contract NASw-6. 98p.

An open literature survey on space flight and applicable data and techniques is presented covering December 1961. The 207 references, with abstracts, are grouped according to subject. Cumulative author and subject indexes for the year are included. (M.C.G.)

9720 (NP-11345) ASTRONAUTICS INFORMATION. Abstracts Vol. V, No. 1, Abstracts 5,001-5,100. B. J. Hardgrove and F. L. Warren, comps. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Jan. 1962. Contract NAS 7-100. 37p.

A total of 99 abstracts is presented on space flight and related material. The abstracts are divided into sections dealing with flight dynamics; vehicle technology; communications, guidance, and control; and space science. Indexes are included. (D.L.C.)

9721 (NP-11353) THERMOELECTRIC GENERATORS AND MATERIALS: RADIATION EFFECTS, RELIABILITY, LIFETIME, AND FAILURE. AN ANNOTATED BIBLIOGRAPHY. E. Graziano, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Jan. 1962. 44p. (SB-61-60)

A bibliography of 88 references with appended abstracts is presented on reliability and radiation effects of thermoelectric generators and materials. References mentioning any factor that might cause failure or malfunction are included. (D.L.C.)

9722 VORTEX CONTAINMENT FOR THE GASEOUS-FISSION ROCKET. Jack L. Kerrebrock and Robert V. Meghreblian (California Inst. of Tech., Pasadena). J. Aero/Space Sci., 28: 710-24(Sept. 1961).

The possibility of retaining fissionable material, in gaseous form, in the pressure field of a vortex, while low molecular weight propellant diffuses radially inward through it, is studied. The study is made in regards to the nuclear rocket where it seems clear that the full potential can be realized only if the fissionable material can be retained in gaseous form, and its fission energy transferred directly to the propellant. A two-dimensional, laminar, vortex flow is studied, the propellant being introduced tangentially at the periphery and withdrawn at the center. The mass-flow capacity of the vortex, per unit of vortex length, is found to be independent of the vortex diameter, so that a large number of small-diameter vortices filling a given volume will have a much larger mass-flow capacity than a single vortex of the same volume. At tangential Mach numbers of the order of unity in a mixture of hydrogen and plutonium, the mass-flow capacity is of the order of 0.01 pounds per second-foot. If the vortex pressure gradient decreases monotonically outward, it is possible to maintain the heavy gas in a highly peaked distribution, away from both the center and the periphery of the vortex; however, for very high heating rates, or very large temperature ratios, the pressure gradient cannot decrease monotonically outward, and in this case the concentration of heavy gas near the periphery of the vortex will be very high. Insofar as the vortex containment mechanism limits the gaseous nuclear rockets, its performance potential is very high. (N.W.R.)

WASTE DISPOSAL AND PROCESSING

9723 (CEA-2003) ETUDE DE LA DILUTION DANS LE RHONE DES EFFLUENTS RADIOACTIFS DU CENTRE DE MARCOULE. (A Study of the Dilution of Radioactive Waste in the Rhone). J. Rodier, J. Scheidhauer, M. Marichal, and R. Court (France. Commissariat à l'Energie Atomique. Centre de Production de Plutonium de Marcoule, Chusclan). 1961. 55p.

The discharge into the Rhône of liquid radioactive waste from the Marcoule Centre necessitates a large number of measurements, in particular chemical and radiochemical analysis of the waste itself and of the waters of the Rhône both above and below the point of discharge. The results thus obtained during 1960 made it possible to evaluate the total amount of active waste discharged and its dilution in the receiving medium. A statistical study of the results of the analysis of the Rhône waters shows that a satisfactory dilution of the waste occurs rapidly; the experimental results obtained with an experimental discharge of rhodamine are thus confirmed. (auth)

9724 (DLCS-2180101) PERIODIC CHARACTERIZATION OF RADIOACTIVE WASTE DISPOSAL SYSTEM EFFLUENTS. Test Evaluation. (Duquesne Light Co., Shippingport, Penna.). First issue, Feb. 2, 1962. Contract [AT(11-1)-292]. 18p.

The major nuclides present in the Radioactive Waste Disposal System effluent water and gas were characterized. The major gamma activity in all of the liquid samples analyzed was Co^{60}. The ion exchangers and gas stripper removed the major activities in both particulate and filterable form and reduced the gross activity to well within limits for discharge to the environment. Sr^{90} was not detectable in the reactor plant effluent. The major activity in the Vent Gas Systems was Xe^{133}. Mn^{54} activity was present in the Decontamination Room effluents in a ratio of 1 to 3 with Co^{60}. (M.C.G.)

9725 (ORNL-3182) STATUS REPORT ON EVALUATION OF SOLID WASTE DISPOSAL AT ORNL. [PART] II. T. F. Lomenick and K. E. Cowser (Oak Ridge National Lab., Tenn.). Feb. 7, 1962. Contract W-7405-Eng-26. 43p.

Burial Ground 4 was opened in February 1951 and closed to routine burial operations in July 1959. The average rate of burial during this period was about $2\frac{1}{2}$ acres per year. The site was underlain by the Conasauga shale of Cambrian age. At the burial ground the formation consisted mostly of maroon and gray shales interbedded with a few thin limestone lenses. Water-level measurements indicated that the buried waste was in contact with ground water during most periods of the year. Activity was detected in water samples from a number of wells located in areas of low topography where ground water contact with the waste was greatest. Radionuclides were also found in seeps and streams within the area. No significant activity from the burial ground was contributed to nearby White Oak Creek. (auth)

9726 SEA WATER MONITORING FOLLOWING RADIOACTIVE WASTE DISPOSAL OPERATIONS. R. E. Alexander (Atomics International, Inc., Canoga Park, Calif.). Health Phys., 7: Nos. 1 and 2, 106-13(Dec. 1961).

Problems associated with sea water monitoring are described, and analytical procedures used at Atomics International for sample analysis and data interpretation are presented. (auth)

9727 PROCESSING OF RADIOACTIVE WASTES. C. A. Mawson (Atomic Energy of Canada Ltd., Chalk River, Ont.). Review Series No. 18 of "Developments in the Peaceful Applications of Nuclear Energy" of the International Atomic Energy Agency, Vienna. Dec. 1961. 44p. (STI/PUB/15/18). $1.00(IAEA).

The development of techniques for processing gaseous, liquid, and solid radioactive wastes between 1955 and 1960 is reviewed. Aspects of waste treatment are emphasized, with little reference to methods of disposal, but an annotated supplementary bibliography is provided that includes papers on waste disposal methods, monitoring and allied subjects. (auth)

9728 PROCEDURE AND APPARATUS FOR THE TREATMENT OF LIQUID RADIOACTIVE WASTES. Belgian Patent 552,692. Water Pollution Abstr., 34: 1511 (Aug. 1961).

Procedure and apparatus are claimed for the treatment of radioactive waste waters from atomic energy establishments. Most of the radioactive elements are removed by adsorption of a column of cellulosic material, the most suitable material being sawdust. Sawdust prepared from poplar wood was found to give the best results (up to 99% decontamination). Before passage through the column the waste waters are treated to remove organic material and also other non-radioactive material which might be adsorbed on the cellulosic material. The adsorbent itself is treated with a disinfectant to delay rotting. The addition of ferric chloride to the waste water before passage through the column increases the fixation of the adsorbent of certain radioactive elements such as ruthenium. It is advantageous to remove the outside layer of adsorbent (first met by the waste water) periodically and in a later development of the process a series of columns is used so that the first column can periodically be taken out of service, the second column becoming the new first column, and so on, with a new final column being inserted. After use, the adsorbent material containing the radioactive substances is mixed with clay and burned. (Water Pollution Abstr.)

CORPORATE AUTHOR INDEX

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Æ	becomes	ae
Ø		oe
ø		oe
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AEEW-R–	**(British)**	
41	16-9186	Dep.; $0.70(BIS)
62	16-9021	Dep.; $0.49(BIS)
112	16-9570	Dep.; $0.42(BIS)
AERE-Bib–	**(British)**	
135	16-9354	Dep.; $0.56(BIS)
AERE-M–	**(British)**	
846	16-9692	Dep.; $0.49(BIS)
921	16-8755	Dep,; $0.42(BIS)
968	16-9091	Dep.; $0.25(BIS)
AERE-R–	**(British)**	
3346	16-8826	Dep.; $1.26(BIS)
3710	16-8707	Dep.; $0.56(BIS)
3751	16-9271	Phil. Mag. (8), 6: 1487-92(1961)
3779	16-8896	Dep.; $0.35(BIS)
3787	16-9251	Dep.; $0.70(BIS)
3847	16-9412	Dep.; $1.40(BIS)
3867	16-8897	Dep.; $0.49(BIS)
3875	16-8672	Dep.; $0.35(BIS)
R-2311	16-9251	For Decl. Vers. see AERE-R-3787
AERE-T–	**(British)**	
M-132	16-9274	Dep.(mc)
AERE-Trans–	**(British)**	
881	16-8684	Dep.
AF-SAM–	**(Non-AEC)**	
61-114	16-8535	
61-115	16-8536	
AFBSD-TR–	**(Non-AEC)**	
61-58	16-9706	
AFCRL–	**(Non-AEC)**	
281	16-9707	OTS
830	16-9187	
AFOSR–	**(Misc.)**	
1521*	16-9491	
1522*	16-9492	
1523*	16-9493	
1830*	16-9708	
1870*	16-9293	See USCEC-83-210
1932*	16-9275	
1940*	16-8827	
2144*	16-9494	
AFSWC-TR–	**(Non-AEC)**	
61-91	16-9276	
AGN–	**(Misc.)**	
3059	16-8971	Dep.(mc); $3.60(fs), $1.34(mf) OTS
AID-Report–	**(Non-AEC)**	
61-7	16-9433	See NP-11297
AMRL–	**(Non-AEC)**	
504	16-8537	
ANL–		
6302	16-9022	Dep.; $3.00(OTS)
6378	16-9344	Dep.; $2.50(OTS)
6441	16-8861	Dep.; $1.25(OTS)
6447	16-9127	Dep.; $1.00(OTS)
6455	16-9277	Dep.; $8.60(fs), $2.97(mf) OTS
6457	16-8828	Dep.; $0.50(OTS)
6465	16-9278	Dep.; $0.50(OTS)
6469	16-9617	Dep.; $3.00(OTS)
AP-Note	**(Non-AEC)**	
283	16-9662	See NP-11296

284	16-9661	See NP-11295
APAE–	**(Misc.)**	
97	16-9618	Dep.(mc); $7.60(fs), $2.51(mf) OTS
100	16-9619	Dep.(mc); $11.00(fs), $4.70(mf) OTS
APAE-Memo–	**(Misc.)**	
299	16-9620	Dep.(mc); $4.60(fs), $1.43(mf) OTS
ARDE(MX)–	**(British)**	
89/60	16-9149	
ARF–	**(Misc.)**	
1164-21	16-9252	Dep.(mc); $2.60(fs), $0.92(mf) OTS
1194-7	16-9067	Dep.(mc); $4.60(fs), $1.70(mf) OTS
ARGMA-TR–	**(Non-AEC)**	
2H2R	16-8829	
ARDD–	**(Misc.)**	
1911.5	16-9437	See TID-14628
2891.1*	16-9188	
ASD-TR–	**(Non-AEC)**	
61-66(Pt.II)	16-9189	OTS
61-273	16-8898	OTS
61-461	16-9158	OTS
AWRE-NR–	**(British)**	
P-7/61	16-9425	
AWRE-O–	**(British)**	
53/61	16-8708	
AWRE-Trans–	**(British)**	
25	16-8685	
26	16-8668	
BAW–	**(Misc.)**	
168*	16-8862	$3.60(fs), $1.22(mf) OTS
BM-RI–	**(Misc.)**	
5851	16-9139	Free (Bureau of Mines)
5910*	16-8802	Free (Bureau of Mines)
5923*	16-8803	Free (Bureau of Mines)
BMI–	**(Misc.)**	
1549(Del.)	16-9190	Dep.; $2.00(OTS)
BN–	**(Non-AEC)**	
271	16-9494	See AFOSR-2144
BNL–		
5088	16-8654	p.151-64 of "Diagnosis and Treatment of Acute Radiation Injury." Geneva, World Health Organization, 1961
5234	16-8788	Rec. trav. chim. 80: 533-6(1961)
5588	16-8489	Am. J. Physiol. 202: 359-63(1962)
5596	16-9315	Phys. Rev. 125: 444-6(1962)
5629	16-9273	Phys. Rev. 125: 451-3(1962)
5630	16-9316	Phys. Rev. 125: 447-50(1962)
CEA–	**(French)**	
10(MH)	16-9476	See TID-13715
36(MH)	16-9477	See TID-13716
2003	16-9723	Dep.(mc)
2037	16-9023	Dep.
2069	16-8985	Dep.(mc)
2075	16-8899	Dep.(mc)
2083	16-9413	Dep.(mc)
CEA-Note–	**(French)**	
352	16-8986	Dep.(mc)
CEA-tr–	**(French)**	
A-1016	16-9525	Dep.(mc); $2.60(fs), $1.07(mf) JCL
A-1024	16-8912	$1.60(fs), $0.80(mf) JCL
A-1025	16-8913	Dep.(mc); $2.60(fs), $1.10(mf) JCL
A-1026	16-9703	Dep.(mc); $3.60(fs), $1.13(mf) JCL
A-1027	16-8914	Dep.(mc); $1.10(fs), $0.80(mf) JCL
R-1408	16-9295	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
R-1409	16-8915	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
R-1417	16-8916	$1.10(fs), $0.80(mf) JCL or OTS
R-1419	16-9296	Dep.(mc); $3.60(fs), $1.13(mf) JCL or OTS
R-1420	16-9584	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
R-1440	16-9219	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
X-315	16-8686	Dep.(mc); $2.60(fs), $1.01(mf) JCL
X-425	16-8763	Dep.(mc); $1.60(fs), $0.80(mf) JCL
CEI–	**(Canadian)**	
62(Rev.)	16-8709	Dep.; $0.50(AECL)
CENC–	**(Misc.)**	
1032*	16-9621	
CEND–	**(Misc.)**	
118	16-9622	Dep.(mc); $3.60(fs), $1.16(mf) OTS
151	16-9623	Dep.(mc); $5.60(fs), $1.91(mf) OTS
CEX–		
62.01	16-9024	Dep.; $0.50(OTS)
CISE-R–	**(Italian)**	
23	16-8867	See EURAEC-41
35	16-8869	See EURAEC-150
37	16-8868	See EURAEC-97
CLM-R–	**(British)**	
13	16-9495	Dep.; $0.56(BIS)
CNEN–	**(Italian)**	
82	16-9571	Dep.(mc)
97	16-8673	Dep.(mc)
98	16-9140	Dep.(mc)
100	16-9693	Dep.(mc)
CNI–	**(Italian)**	
101	16-8756	
CR–	**(Misc.)**	
46*	16-9718	See NP-11161
CRGM–	**(Canadian)**	
1034	16-8976	Dep.; $0.50(AECL)
CRGP–	**(Canadian)**	
1056	16-9336	Dep.; $2.00(AECL)
CRIO–	**(Canadian)**	
1043	16-9694	Dep.; $2.00(AECL)
CRP–	**(Canadian)**	
1055	16-8900	Dep.; $0.50(AECL)
CRRL–	**(Canadian)**	
1054	16-8972	Dep.; $0.50(AECL)
CRRP–	**(Canadian)**	
1064	16-9572	Dep.; $1.50(AECL)
CUA-NE–		
17	16-9624	Dep.(mc); $1.60(fs), $0.88(mf) OTS
CVNA–	**(Misc.)**	
107	16-9128	Dep.(mc); $8.60(fs), $3.20(mf) OTS
D–	**(Misc.)**	
1-82-0131*	16-9496	
1-82-0146*	16-9497	
DC–	**(Misc.)**	
51-11-26	16-9550	Dep.(mc); $3.60(fs), $1.16(mf) OTS
54-4-71	15-9159	Dep.(mc); $6.60(fs), $2.24(mf) OTS
57-2-115	16-9160	Dep.(mc); $3.60(fs), $1.22(mf) OTS
57-2-119	16-9129	Dep.(mc); $3.60(fs), $1.25(mf) OTS
57-11-150	16-9130	Dep.(mc); $2.60(fs), $1.04(mf) OTS
57-12-182	16-9426	Dep.(mc); $1.60(fs), $0.80(mf) OTS
57-12-710	16-9625	Dep.(mc); $6.60(fs), $2.06(mf) OTS
58-1-191	16-9626	Dep.(mc); $2.60(fs), $0.98(mf) OTS
58-2-118	16-9627	Dep.(mc); $21.00(fs), $9.68(mf) OTS
58-4-152	16-9628	Dep.(mc); $2.60(fs), $0.92(mf) OTS
58-6-182	16-8863	Dep.(mc); $2.60(fs), $0.83(mf) OTS
58-6-229	16-9695	Dep.(mc); $4.60(fs), $1.58(mf) OTS
58-8-77	16-8830	Dep.(mc); $5.60(fs), $1.91(mf) OTS
58-8-223	16-9573	Dep.(mc); $7.60(fs), $2.48(mf) OTS
58-11-103	16-9191	Dep.(mc); $3.60(fs), $1.25(mf) OTS
59-2-86	16-9161	Dep.(mc); $1.60(fs), $0.80(mf) OTS
59-3-223	16-8864	Dep.(mc); $5.60(fs), $1.73(mf) OTS
59-4-27	16-9192	Dep.(mc); $4.60(fs), $1.49(mf) OTS
59-4-42	16-8865	Dep.(mc); $3.60(fs), $1.34(mf) OTS
59-4-115	16-8866	Dep.(mc); $3.60(fs), $1.22(mf) OTS
59-6-195	16-9253	Dep.(mc); $3.60(fs), $1.40(mf) OTS
59-6-208	16-8901	Dep.(mc); $4.60(fs), $1.46(mf) OTS
59-7-2	16-9574	Dep.(mc); $4.60(fs), $1.43(mf) OTS
DCL–		
59-5-216	16-9629	Dep.(mc); $1.10(fs), $0.80(mf) OTS
DCP–		
59-471	16-9630	Dep.(mc); $11.00(fs), $4.46(mf) OTS
DEG-Report–	**(British)**	

248	16-9355	Dep.; $0.56(BIS)
DESY-A–	**(German)**	
2.79	16-9279	Dep.(mc)
2.83	16-8831	Dep.(mc)
DLCS–		
1480116	16-9631	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1650102	16-8973	Dep.(mc); $4.60(fs), $1.64(mf) OTS
2150201	16-9632	Dep.(mc); $3.60(fs), $1.13(mf) OTS
2180101	16-9724	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3070103	16-9633	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3170102	16-9634	Dep.(mc); $3.60(fs), $1.28(mf) OTS
3360103	16-8909	See TID-14883
3360301	16-8909	See TID-14883
3370103	16-9635	Dep.(mc); $5.60(fs), $1.79(mf) OTS
3380102	16-9636	Dep.(mc); $4.60(fs), $1.58(mf) OTS
3420104	16-9637	Dep.(mc); $3.60(fs), $1.16(mf) OTS
3430102	16-9638	Dep.(mc); $4.60(fs), $1.58(mf) OTS
3430103	16-9639	Dep.(mc); $5.60(fs), $1.82(mf) OTS
3570104	16-9640	Dep.(mc); $1.60(fs), $0.83(mf) OTS
DMIC-Memo–	**(Non-AEC)**	
141	16-9193	OTS
143	16-9162	
DOFL-TR–	**(Non-AEC)**	
975(Vol.I, Pt.1)	16-9254	
Dok-Lit-Inf.–	**(German)**	
40	16-9691	See NP-11343
DP–		
373	16-8902	Dep.; $0.50(OTS)
667	16-9255	Dep.; $0.50(OTS)
685	16-9641	Dep.; $0.75(OTS)
DUENA REPORTS	**(Russian)**	
See JINR (Russian)		
ER–	**(Misc.)**	
4166*	16-8910	See WADD-TR-60-698(Pt.II)
ERR-AN–	**(Non-AEC)**	
072	16-9280	
EURAEC–		
41	16-8867	Dep.(mc); $6.60(fs), $2.27(mf) OTS
97	16-8868	Dep.(mc); $1.10(fs), $0.80(mf) OTS
117	16-9163	Dep.(mc); $1.10(fs), $0.80(mf) OTS
150	16-8869	Dep.(mc); $11.00(fs), $4.45(mf) OTS
FRL-TN–	**(Non-AEC)**	
41	16-8841	
FRM–	**(German)**	
27	16-8913	For French translation see CEA-tr-A-1025
30	16-9703	For French translation see CEA-tr-A-1026
32	16-8914	For French translation see CEA-tr-A-1027
FTD-TT–	**(Non-AEC)**	
61-56	16-8917	OTS
61-93	16-9526	OTS
61-113	16-9527	OTS
61-127	16-9220	OTS
61-170	16-9585	OTS
61-196	16-9528	OTS
61-198	16-8880	OTS
61-226	16-9297	OTS
61-261	16-8918	OTS
61-282	16-9529	OTS
61-314	16-9333	OTS
61-321	16-8881	OTS
61-394	16-9363	OTS
FXM–	**(Misc.)**	
3389*	16-9256	
3932*	16-9257	
4986	16-9194	Dep.(mc); $1.60(fs), $0.80(mf) OTS
FZM–	**(Non-AEC)**	
2029	16-8987	
2276	16-8988	
2278(Rev.A)	16-8989	
GA–	**(Misc.)**	
1954	16-9642	Dep.; $2.75(OTS)
2451(Vol.III)	16-9427	Dep.(mc); $12.50(fs), $5.51(mf) OTS
2471	16-9345	Dep.(mc); $7.60(fs), $2.42(mf) OTS
2684	16-9643	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2886*	16-9258	
GAMD–	**(Misc.)**	
1370	16-9644	Dep.(mc); $2.60(fs), $0.89(mf) OTS
1454	16-9645	$1.60(fs), $0.80(mf) OTS
1766	16-9131	Dep.(mc); $5.60(fs), $1.85(mf) OTS
GAT-T–		
823	16-8691	Appl. Spectroscopy 15: 150-2(1961)
961	16-8710	Dep.(mc); $1.10(fs), $0.80(mf) OTS
GEAP–	**(Misc.)**	
3567	16-9646	Dep.; $1.25(OTS)
3778	16-9647	Dep.; $1.25(OTS)
GEMP–		
7A	16-9195	Dep.; $1.50(OTS)
103A	16-9196	Dep.; $0.50(OTS)
GNEC–		
156	16-9648	Dep.; $0.75(OTS)
192	16-9649	Dep.; $1.75(OTS)
HPR–	**(Norwegian)**	
15	16-9650	Dep.(mc)
HW–		
62875	16-9150	Dep.(mc); $1.60(fs), $0.80(mf) OTS
63137	16-9197	Dep.(mc); $2.60(fs), $0.92(mf) OTS
64573	16-9198	Dep.(mc); $1.60(fs), $0.80(mf) OTS
64788	16-8974	Dep.(mc); $1.60(fs), $0.80(mf) OTS
66262	16-9281	Dep.(mc); $2.60(fs), $0.92(mf) OTS
67641	16-9199	Dep.(mc); $1.10(fs), $0.80(mf) OTS
68284	16-9575	Dep.(mc); $1.60(fs), $0.80(mf) OTS
68493	16-9164	Dep.; $1.00(OTS)
68596	16-9651	Dep.(mc); $3.60(fs), $1.28(mf) OTS
68613	16-9151	Dep.(mc); $1.60(fs), $0.80(mf) OTS
68913	16-8832	Dep.(mc); $1.60(fs), $0.80(mf) OTS
68934(Rev.)	16-8870	Dep.; $1.00(OTS)
69393	16-9259	Dep.; $0.50(OTS)
69401	16-9165	Dep.; $6.60(fs), $2.03(mf) OTS
69506	16-8804	Dep.(mc); $1.60(fs), $0.80(mf) OTS
69525	16-9346	Dep.; $2.25(OTS)
69697	16-8711	Dep.(mc); $1.10(fs), $0.80(mf) OTS
69781	16-8833	Dep.(mc); $1.10(fs), $0.80(mf) OTS
70791	16-8871	Dep.; $0.50(OTS)
70998	16-8805	Dep.(mc); $3.60(fs), $1.25(mf) OTS
71389	16-8872	Dep.(mc); $1.60(fs), $0.80(mf) OTS
71545	16-9132	Dep.(mc); $5.60(fs), $1.85(mf) OTS
71710	16-8903	Dep.(mc); $2.60(fs), $0.83(mf) OTS
71756	16-9152	Dep.; $1.60(fs), $0.80(mf) OTS
71837	16-9200	Dep.(mc); $1.60(fs), $0.80(mf) OTS
72117	16-9133	Dep.(mc); $4.60(fs), $1.70(mf) OTS
72295	16-8834	Dep.(mc); $1.10(fs), $0.80(mf) OTS
HW-SA–		
1908	16-9055	Health Phys. 7: Nos. 1 and 2, 81-6(1961)
2040	16-9047	Health Phys. 7: Nos. 1 and 2, 1-10(1961)
HW-tr–		
31	16-9268	Dep.(mc); $3.60(fs), $1.13(mf) JCL
IA–	**(Non-AEC)**	
670	16-8990	Dep.(mc)
IDO–		
14555	16-8806	Dep.(mc); $5.60(fs), $1.73(mf) OTS
14567	16-8666	Dep.; $1.75(OTS)
14576	16-8674	Dep.; $0.50(OTS)
14577	16-8807	Dep.(mc); $5.60(fs), $1.82(mf) OTS
16688	16-8904	Dep.; $1.50(OTS)
16726	16-9652	Dep.; $0.75(OTS)
16733	16-9696	Dep.; $1.00(OTS)
IFA-CO–	**(Rumanian)**	
16	16-8757	
IFA-DF–	**(Rumanian)**	
13	16-8712	Dep.(mc)
IFA-RS–	**(Rumanian)**	
16	16-8905	Dep.(mc)

IG-Int. Ser.–	(British)	
45	16-8842	Dep.
IISJ–	(Japanese)	
43	16-9471	Dep.(mc)
45	16-9356	Dep.(mc)
46	16-9472	Dep.(mc)
IP–	(Non-AEC)	
352	16-8758	See NP-11262
IS–		
369	16-9564	Nuovo cimento (10), 22: 643-9(1961)
386	16-9282	Dep.; $2.50(OTS)
JINR–	(Russian)	
P-811	16-9473	Dep.(mc)
P-822	16-9428	Dep.(mc)
JLI–		
650-5-2	16-8445	Dep.(mc); $0.50(OTS)
JPL-TR–	(Non-AEC)	
32-158	16-9709	
32-159	16-9710	
32-189	16-9576	
JPRS–	(Non-AEC)	
10349	16-9298	OTS
11289	16-8728	OTS
11293	16-8843	OTS
11405	16-8467	OTS
11452	16-8764	OTS
11725	16-9530	OTS
11816	16-8547	OTS
11848	16-8630	OTS
11901	16-8550	OTS
11903	16-8551	OTS
11942	16-8635	OTS
12021	16-8552	OTS
12102	16-8553	OTS
12194	16-8470	OTS
JRL–	(German)	
23-ST	16-8453	Dep.(mc)
25-RE	16-9347	Dep.(mc)
KAPL–		
2000-16	16-9653	Dep.; $2.75(OTS)
2170	16-8873	Dep.; $2.50(OTS)
2171	16-9166	Dep.; $0.75(OTS)
KAPL-M–		
AHA-2	16-8675	Dep.(mc); $1.10(fs), $0.80(mf) OTS
EEB-17	16-9260	Dep.(mc); $5.60(fs), $1.91(mf) OTS
FW-4	16-8676	Dep.(mc); $2.60(fs), $0.98(mf) OTS
JVM-2	16-9167	Dep.(mc); $2.60(fs), $1.01(mf) OTS
PJT-9	16-9429	Dep.(mc); $3.60(fs), $1.31(mf) OTS
WAO-13	16-9168	Dep.(mc); $5.60(fs), $1.82(mf) OTS
KN–	(Non-AEC)	
60-57(R)	16-9414	
LA–		
2641	16-9025	Dep.; $0.50(OTS)
LAMS–		
2616	16-9557	Dep.; $1.00(OTS)
2650	16-9577	Dep.; $0.50(OTS)
2651	16-9498	Dep.; $0.50(OTS)
LMSD–	(Non-AEC)	
288084	16-9711	
M–	(Misc.)	
276	16-9480	See TID-14224
MAB–	(Non-AEC)	
175-M(Vol.I)	16-9201	
MATT–		
1(3rd Ed.)	16-9499	Dep.(mc); $3.60(fs), $1.25(mf) OTS
MATT-Q–		
17	16-9500	Dep.(mc); $4.60(fs), $1.46(mf) OTS
MLM–		
1080	16-8735	J. Am. Ceram. Soc. 45: 79-83(1962)
MND–	(Misc.)	
2584-2	16-9202	Dep.(mc); $3.60(fs), $1.40(mf) OTS
2584-3	16-9068	Dep.(mc); $5.60(fs), $1.94(mf) OTS
MND-E–	(Misc.)	
2681*	16-9153	
MND-M–	(Misc.)	
1821	16-9654	Dep.(mc); $5.60(fs), $2.00(mf) OTS
2583	16-9655	Dep.(mc); $14.00(fs), $6.29(mf) OTS
3A-2451	16-9656	Dep.(mc); $5.60(fs), $1.76(mf) OTS
MND-P–		
1972	16-8808	Dep.(mc); $2.60(fs), $1.04(mf) OTS
MPR-XIII–		
12-61	16-8875	See TID-14664
MR-N–	(Non-AEC)	
265	16-9261	See NARF-61-42T
290	16-9431	See NARF-61-38T
MRL–	(Non-AEC)	
107	16-9430	
MS–	(British)	
91(2nd. Ed.)	16-9415	Dep.; $0.42(BIS)
91A	16-9415	Included in MS-91(2nd. Ed.)
MSAR–	(Misc.)	
62-05	16-9697	Dep.(mc); $4.60(fs), $1.56(mf) OTS
MURA–	(Misc.)	
405	16-9357	Dep.(mc); $1.10(fs), $0.80(mf) OTS
466	16-9474	Dep.(mc); $1.60(fs), $0.80(mf) OTS
510	16-9475	Dep.(mc); $1.10(fs), $0.80(mf) OTS
NAA-SR–		
269	16-8809	Dep.(mc); $2.60(fs), $0.86(mf) OTS
1109	16-9657	Dep.(mc); $9.10(fs), $3.23(mf) OTS
5416	16-9658	Dep.; $1.50(OTS)
6666	16-8810	Dep.; $0.50(OTS)
6802	16-8811	Dep.; $0.50(OTS)
NAA-SR-Memo–		
1891	16-9551	Dep.(mc); $2.60(fs), $0.98(mf) OTS
5202(Rev.)	16-9348	Dep.(mc); $1.10(fs), $0.80(mf) OTS
6596	16-8812	Dep.(mc); $2.60(fs), $0.89(mf) OTS
NARF–	(Non-AEC)	
61-38T	16-9431	
61-42T	16-9261	
NASA-TN–	(Misc.)	
D-474*	16-9712	$1.00(OTS)
D-587*	16-9713	$1.75(OTS)
D-878*	16-9714	
D-1004*	16-9715	$0.50(OTS)
D-1010*	16-9337	$0.75(OTS)
D-1098*	16-8991	$0.50(OTS)
D-1110*	16-9716	
D-1163*	16-9717	$1.00(OTS)
D-1165*	16-8874	$1.00(OTS)
D-1187*	16-9283	$0.75(OTS)
NBS-TN–	(Non-AEC)	
109	16-9284	$1.25(OTS) as PB-161610
116	16-9285	OTS as PB-161617
120	16-9286	$1.75(OTS) as PB-161621
NDA–	(Misc.)	
2131-43	16-9578	Dep.(mc); $4.60(fs), $1.58(mf) OTS
2131-44	16-9659	Dep.(mc); $2.60(fs), $0.92(mf) OTS
84-16(Vols.I&II)	16-9698	Dep.; $4.50(OTS)
NEPA–	(Misc.)	
1841*	16-8713	$6.60(fs), $2.30(mf) OTS
NMI–	(Misc.)	
2101	16-9141	Dep.(mc); $1.60(fs), $0.80(mf) OTS
4771	16-9169	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7241	16-9660	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NP–	(AEC File No. for Non-AEC Reports)	
11161	16-9718	
11225	16-9558	
11234	16-9203	
11235	16-9204	
11237	16-9338	
11238	16-9170	
11241	16-8714	

11243	16-8835	
11251	16-8454	
11254	16-8455	
11256	16-8456	
11257	16-8457	
11259	16-8458	
11260	16-8459	
11262	16-8758	
11263	16-9358	Dep.(mc)
11264	16-9142	
11272	16-9699	Dep.(mc); $9.10(fs), $3.44(mf) OTS
11278	16-8460	
11280	16-9432	Dep.(mc)
11284	16-9171	
11285	16-9287	
11286	16-8461	
11287	16-9205	
11290	16-8715	
11294	16-9433	
11295	16-9661	
11296	16-9662	
11298	16-8462	
11302	16-9288	$3.50(OTS)
11306	16-9026	
11315	16-9289	OTS
11321	16-9719	
11327	16-9559	
11333	16-9700	Dep.(mc); $12.50(fs), $5.51(mf) OTS
11335	16-9501	
11336	16-9262	
11340	16-9206	
11343	16-9691	Dep.(mc)
11345	16-9720	
11348	16-9207	
11351	16-9172	
11352	16-8716	
11353	16-9721	
11358	16-9359	
11360	16-9434	
NP-tr-	(AEC File No. for Non-AEC Translations)	
829	16-9483	Dep.(mc); $2.60(fs), $0.86(mf) JCL or OTS
835	16-8883	
845	16-8919	Dep.(mc); $2.60(fs), $0.98(mf) JCL
847	16-9034	Dep.(mc); $1.10(fs), $0.80(mf) JCL
849	16-8800	Dep.(mc); $2.60(fs), $0.95(mf) JCL
857	16-9221	Dep.(mc); $1.60(fs), $0.80(mf) JCL
NRL-	(Misc.)	
5731*	16-9263	
NYO-		
2631	16-9069	Dep.; $3.00(OTS)
2695	16-9143	Dep.; $0.50(OTS)
9064	16-9663	Dep.; $3.00(OTS)
9574	16-8463	Dep.(mc); $3.60(fs), $1.25(mf) OTS
9756	16-9134	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9764	16-9290	Dep.(mc); $6.60(fs), $2.27(mf) OTS
9862	16-8667	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10009	16-9208	Dep.; $0.50(OTS)
10057	16-8480	Dep.(mc); $1.10(fs), $0.80(mf) OTS
ORNL-		
3182	16-9725	Dep.; $1.00(OTS)
3210	16-9664	Dep.; $3.50(OTS)
3215	16-9665	Dep.; $2.75(OTS)
3232	16-9502	Dep.; $0.50(OTS)
3239	16-9503	Dep.; $2.25(OTS)
3240	16-9435	Dep.; $2.25(OTS)
3241	16-8717	Dep.; $0.50(OTS)
3243	16-8677	Dep.; $2.50(OTS)
ORNL-TM-		
10	16-9701	Dep.(mc); $9.10(fs), $3.38(mf) OTS
22	16-8813	Dep.(mc); $1.60(fs), $0.80(mf) OTS
111	16-8814	Dep.(mc); $1.60(fs), $0.80(mf) OTS
113	16-8678	Dep.(mc); $1.10(fs), $0.80(mf) OTS
114	16-9579	Dep.(mc); $1.10(fs), $0.80(mf) OTS
135	16-9209	Dep.(mc); $3.60(fs), $1.16(mf) OTS
139	16-9027	Dep.(mc); $1.10(fs), $0.80(mf) OTS
ORO-		
325(Pt.2)	16-8718	Dep.(mc); $2.60(fs), $1.10(mf) OTS
462	16-8906	Dep.(mc); $5.60(fs), $1.97(mf) OTS
500	16-9512	Dep.(mc); $4.60(fs), $1.43(mf) OTS
508	16-8719	Dep.(mc); $1.60(fs), $0.80(mf) OTS
515	16-9173	Dep.(mc); $1.10(fs), $0.80(mf) OTS
522	16-9580	$9.60(fs), $3.65(mf) OTS
OSR-	(Non-AEC)	
21	16-8827	See AFOSR-1940
PATENTS	(Belgian)	
552,692	16-9728	
PATENTS	(British)	3s. 6d. each, U. K. Patent Office
884,410	16-9180	
887,392	16-9592	
887,440	16-8795	
887,490	16-8848	
887,556	16-8704	
887,561	16-9593	
887,566	16-9090	
887,591	16-8963	
887,650	16-9594	
887,659	16-8849	
887,695	16-8850	
887,712	16-9595	
887,713	16-9596	
887,781	16-8964	
887,797	16-9181	
887,881	16-9597	
887,950	16-8796	
887,953	16-8753	
887,954	16-9598	
888,082	16-8797	
888,089	16-8852	
888,107	16-8479	
888,108	16-9545	
888,155	16-8853	
888,713	16-8854	
888,720	16-9546	
888,730	16-8798	
888,776	16-8851	
888,879	16-8965	
888,884	16-9126	
888,888	16-9547	
888,889	16-8966	
888,894	16-8967	
888,959	16-8968	
889,042	16-9599	
889,140	16-8705	
889,153	16-9148	
889,170	16-8799	
889,191	16-9248	
889,197	16-9600	
889,198	16-8855	
889,200	16-9601	
889,203	16-9602	
PATENTS	(Dutch)	
98,129	16-9094	See AEC-tr-4992
PATENTS	(French)	
752,436	16-9554	See AEC-tr-4882
775,380	16-9553	See AEC-tr-4881
PATENTS	(German)	
1,060,360	16-9093	See AEC-tr-4990
PATENTS	(Japanese)	
8,479	16-9095	See AEC-tr-4993
PATENTS	(U. S.)	$0.25 each, U. S. Patent Office
3,020,632	16-9182	
3,020,647	16-8856	

3,020,736	16-8857	
3,020,750	16-8969	
3,021,272	16-9548	
3,021,708	16-8970	
3,022,134	16-8823	
3,022,160	16-8824	
3,022,162	16-9249	
3,022,236	16-9549	
3,022,240	16-9603	
3,022,933	16-8858	
3,023,040	16-8859	
3,023,078	16-8983	
3,023,085	16-8754	
3,023,097	16-8825	
3,023,119	16-8860	
PB–	**(Non-AEC)**	
161610	16-9284	See NBS-TN-109
161617	16-9285	See NBS-TN-116
161621	16-9286	See NBS-TN-120
PG-Report–	**(British)**	
212	16-8679	Dep.; $0.21(BIS)
226	16-8680	Dep.
262	16-8681	Dep.; $0.21(BIS)
PIBAL–	**(Non-AEC)**	
645	16-9516	
PIBMRI–	**(Non-AEC)**	
910-61	16-9517	
PRWRA-GNEC–		
4	16-9666	Dep.; $1.00(OTS)
PWAC–	**(Misc.)**	
112	16-9581	Dep.(mc); $4.60(fs), $1.84(mf) OTS
RADC-TN–	**(Non-AEC)**	
61-94	16-9516	See PIBAL-645
61-124	16-9517	See PIBMRI-910-61
RFP–		
248	16-9349	Dep.; $0.50(OTS)
RIB–		
46	16-8907	Dep.(mc); $1.60(fs), $0.80(mf) OTS
RISO–	**(Danish)**	
31	16-8908	Dep.(mc)
SB–	**(Non-AEC)**	
61-60	16-9721	See NP-11353
SCR–		
267	16-8975	Dep.(mc); $2.60(fs), $0.89(mf) OTS
SCTM–		
29-59(15)	16-8836	Dep.(mc); $1.60(fs), $0.80(mf) OTS
300-61(14)	16-8837	Dep.(mc); $1.10(fs), $0.80(mf) OTS
SGAE–	**(Austrian)**	
196I/4B	16-9135	
SRO–		
64	16-9667	Dep.(mc); $1.60(fs), $0.80(mf) OTS
STI-PUB–	**(International Atomic Energy Agency)**	
15/18	16-9727	$1.00(IAEA)
15/19	16-9690	$1.00(IAEA)
SUI–	**(Misc.)**	
61-16*	16-9339	
TEI–		
804	16-8992	Dep.(mc); $5.60(fs), $1.97(mf) OTS
TH–	**(Japanese)**	
41	16-9471	See INSJ-43
42	16-9472	See INSJ-46
TID–		
3096	16-9210	Dep.; $2.50(OTS)
3303(Suppl.1)	16-9552	Dep.; $2.25(OTS)
5900	16-9136	Dep.(mc); $1.60(fs), $0.80(mf) OTS
11411	16-8682	Dep.(mc); $1.10(fs), $0.80(mf) OTS
11539	16-8838	Dep.(mc); $1.60(fs), $0.80(mf) OTS
13028	16-9668	Dep.(mc); $6.60(fs), $2.30(mf) OTS
13328	16-8481	Dep.(mc); $10.50(fs), $4.34(mf) OTS
13436	16-9669	Dep.(mc); $5.60(fs), $1.94(mf) OTS
13715	16-9476	$1.60(fs), $0.80(mf) OTS
13716	16-9477	Dep.(mc); $1.60(fs), $0.80(mf) OTS
13721	16-9478	Dep.(mc); $2.60(fs), $0.98(mf) OTS
13956	16-9479	Dep.(mc); $4.60(fs), $1.43(mf) OTS
14001	16-9264	Dep.(mc); $3.60(fs), $1.19(mf) OTS
14201	16-8538	Dep.(mc); $2.60(fs), $0.92(mf) OTS
14211	16-9436	Dep.(mc); $2.60(fs), $0.86(mf) OTS
14224	16-9480	Dep.(mc); $2.60(fs), $1.10(mf) OTS
14377	16-9028	Dep.; $0.50(OTS)
14428	16-8720	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14430	16-8482	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14437	16-8993	Dep.(mc); $9.60(fs), $3.59(mf) OTS
14479	16-9137	Dep.(mc); $6.60(fs), $2.03(mf) OTS
14482	16-9265	Dep.(mc); $2.60(fs), $0.89(mf) OTS
14541	16-8539	Dep.(mc); $7.60(fs), $2.33(mf) OTS
14560	16-8446	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14561	16-9211	Dep.(mc); $2.60(fs), $0.92(mf) OTS
14566	16-9212	Dep.(mc); $3.60(fs), $1.16(mf) OTS
14570	16-9416	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14628	16-9437	Dep.(mc); $7.60(fs), $2.60(mf) OTS
14629	16-9670	Dep.(mc); $4.60(fs), $1.49(mf) OTS
14660	16-8721	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14664	16-8875	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14687	16-9671	Dep.(mc); $4.60(fs), $1.46(mf) OTS
14690	16-9213	Dep.(mc); $3.60(fs), $1.28(mf) OTS
14693	16-9266	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14694	16-8815	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14741	16-8683	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14772	16-9029	Dep.(mc); $11.00(fs), $4.46(mf) OTS
14774	16-8540	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14776	16-9030	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14777	16-9154	Dep.(mc); $7.60(fs), $2.54(mf) OTS
14778	16-8722	Dep.(mc); $3.60(fs), $1.40(mf) OTS
14786	16-9438	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14787	16-8723	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14788	16-8724	Dep.(mc); $2.60(fs), $0.86(mf) OTS
14809	16-8541	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14810	16-9214	Dep.(mc); $4.60(fs), $1.87(mf) OTS
14822	16-9439	Dep.(mc); $10.50(fs), $4.25(mf) OTS
14823	16-9440	$1.10(fs), $0.80(mf) OTS
14824	16-9582	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14826	16-8759	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14827	16-9360	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14828	16-8464	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14829	16-8542	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14830	16-8760	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14831	16-8543	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14845	16-8483	Dep.(mc); $4.60(fs), $1.52(mf) OTS
14846	16-9361	Dep.(mc); $6.60(fs), $2.24(mf) OTS
14848	16-8544	Dep.(mc); $13.50(fs), $6.17(mf) OTS
14849	16-8484	Dep.(mc); $6.60(fs), $2.15(mf) OTS
14850	16-8761	Dep.(mc); $4.60(fs), $1.52(mf) OTS
14851	16-8762	Dep.(mc); $5.60(fs), $1.94(mf) OTS
14852	16-9155	Dep.(mc); $3.60(fs), $1.40(mf) OTS
14853	16-8465	Dep.(mc); $18.50(fs), $9.20(mf) OTS
14854	16-9441	Dep.(mc); $4.60(fs), $1.52(mf) OTS
14856	16-9481	Dep.(mc); $4.60(fs), $1.52(mf) OTS
14857	16-8545	Dep.(mc); $3.60(fs), $1.27(mf) OTS
14858	16-8485	Dep.(mc); $9.10(fs), $3.41(mf) OTS
14860	16-9291	Dep.(mc); $4.60(fs), $1.49(mf) OTS
14866	16-8546	Dep.(mc); $9.10(fs), $3.35(mf) OTS
14870	16-9292	Dep.(mc); $8.10(fs), $2.87(mf) OTS
14878	16-9215	Dep.(mc); $7.60(fs), $2.48(mf) OTS
14879	16-9672	Dep.(mc); $5.60(fs), $1.73(mf) OTS
14883	16-8909	Dep.(mc); $2.60(fs), $1.01(mf) OTS
14951	16-9267	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14955	16-9156	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14963	16-9442	Dep.(mc); $3.60(fs), $1.25(mf) OTS
TRG–	**(Misc.)**	
132-QTR-10	16-8667	See NYO-9862
UCLA–		
498	16-8486	Dep.(mc); $2.60(fs), $0.95(mf) OTS

UCRL–		
5794-T	16-8447	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5956	16-9583	Dep.; $0.50(OTS)
6314	16-9461	Phys. Rev. 125: 626-8(1962)
6453	16-9386	Phys. Rev. 125: 734-44(1962)
6585	16-9518	Dep.; $0.75(OTS)
6649	16-9138	Dep.; $0.50(OTS)
6660	16-9417	Dep.; $0.50(OTS)
9212	16-8921	Health Phys. 7: Nos. 1 and 2, 40-7(1961)
9497(Rev.)	16-9467	Phys. Rev. 125: 701-13(1962)
9548(Rev.)	16-9382	Phys. Rev. 125: 690-700(1962)
9606	16-9362	Dep.; $1.75(OTS)
9776	16-9334	J. Opt. Soc. Am. 52: 222(1962)
9779	16-9326	Phys. Rev. 125: 613-25(1962)
9856	16-9381	Phys. Rev. 125: 687-90(1962)
9875(Vol.I)	16-9560	Dep.; $2.25(OTS)
UCRL-Trans–		
761(L)	16-9300	Dep.(mc); $1.60(fs), $0.80(mf) JCL
766(L)	16-8687	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
767(L)	16-9445	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
777(L)	16-9301	$22.25(fs), $9.88(mf) JCL or OTS
USCEC–	**(Non-AEC)**	
83-210	16-9293	OTS
USNRDL-TR–	**(Non-AEC)**	
541	16-8725	
VDIT–	**(Swedish)**	
48	16-8448	Dep.(mc)
WADD-TR–	**(Non-AEC)**	
60-698(Pt.II)	16-8910	
60-782(Pt.III)	16-9144	OTS
60-782(Pt.VI)	16-8726	OTS
WAL-TR–	**(Non-AEC)**	
830.5/3	16-8876	
WAPD-MRP–		
95	16-9673	Dep.; $2.50(OTS)
WAPD-T–		
1429	16-9674	Dep.; $1.75(OTS)
WASH–		
1034	16-9443	Dep.; $0.75(OTS)
WCAP–	**(Misc.)**	
1391(Rev.)*	16-9675	Dep.(mc)
1620*	16-9676	Dep.(mc)
4062	16-9677	Dep.(mc); $2.60(fs), $0.83(mf) OTS
WT–	**(Misc.)**	
1421*	16-9031	Dep.(mc); $6.60(fs), $2.30(mf) OTS
1422*	16-9032	Dep.(mc); $9.10(fs), $3.41(mf) OTS
XDC–		
55-11-101	16-9678	Dep.(mc); $3.60(fs), $1.31(mf) OTS
XDCL–		
60-7-718	16-9216	Dep.(mc); $3.60(fs), $1.16(mf) OTS